

APPENDIX H
Endangered Species Act Coordination Documents

Planning Division
Environmental Branch

Mr. James J. Slack
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960-3559

Dear Mr. Slack:

The U.S. Army Corps of Engineers (Corps), Jacksonville District proposes to conduct a feasibility study to assess Federal interest in navigation improvements throughout the Port of Miami, Miami-Dade County, Florida. An evaluation of benefits, costs, and environmental impacts determines Federal interest.

The recommended plan includes five components: (1) flaring the existing 500-foot wide entrance channel to provide an 800-foot wide entrance channel at Buoy 1, and deepening the entrance channel and widener from an existing depth of 44 feet to a depth of 52 feet; (2) widening the southern intersection of Cut-3 with Lummus Island (Fisherman's) Channel at Buoy 15, and deepening from existing depth of 42 feet to 50 feet; (3) extending the existing Fisher Island turning basin to the north by approximately 300 feet near the west end of Cut-3, and deepening from 43 to 50 feet; (4) relocating the west end of the main channel to about 250 feet to the south (without dredging); and (5) increasing the width of Lummus Island Cut (Fisherman's Channel) about 100 feet to the south of the existing channel, reducing the existing size of the Lummus Island (or Middle) turning basin to a diameter of 1,500 feet, and deepening from the existing 42-foot depth to 50 feet. Additional activities will include mitigation for unavoidable environmental impacts.

Enclosed please find the Corps' Biological Assessment (BA) of the effects of the project as currently proposed on listed species in the action area. After preparing this BA of the impacts of the proposed project, the Corps has determined that the proposed project may affect, but is not likely to adversely affect the endangered American crocodile (*Crocodylus acutus*) and the endangered Florida manatee (*Trichechus manatus*) and is not likely to adversely designated critical habitat for either species. We request that you concur with this finding.

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If you have any questions, please contact Ms. Terri Jordan
at 904-899-5195 or terri.l.jordan@saj02.usace.army.mil.

Sincerely,

James C. Duck
Chief, Planning Division

Enclosure

Jordan/CESAJ-PD-EA/3453/
McAdams/CESAJ-PD-EA
Dugger/CESAJ-PD-E
Schwichtenberg/CESAJ-DP-C
Strain/CESAJ-PD-P
Duck/CESAJ-PD

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Consultation - FWS Cover letter.doc

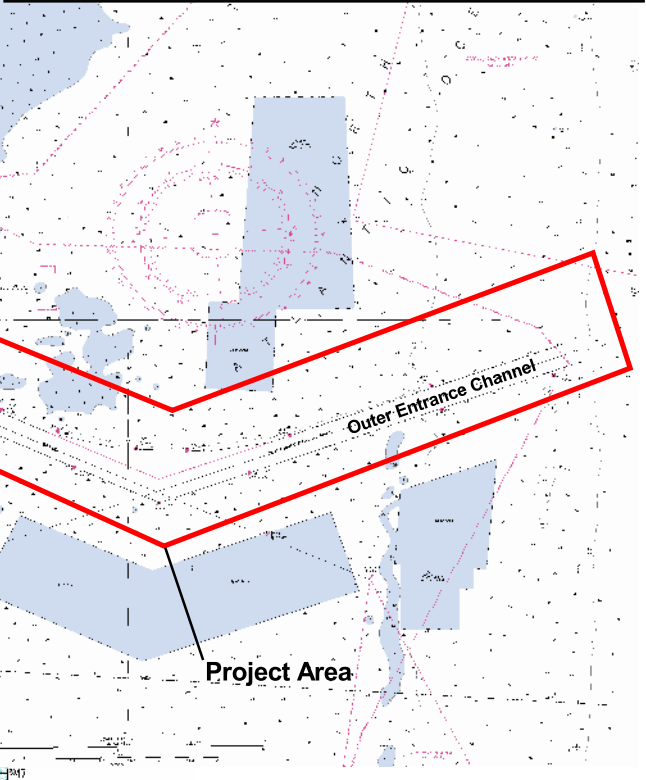
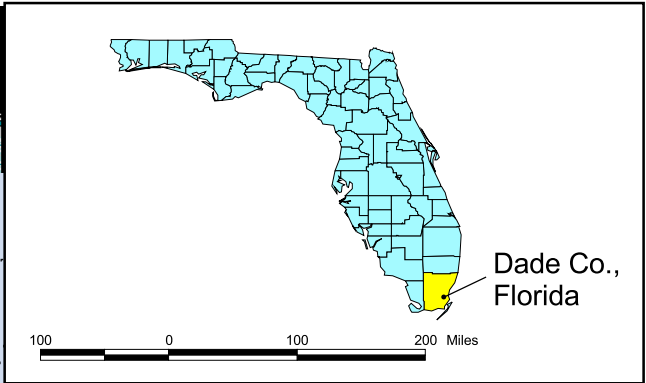
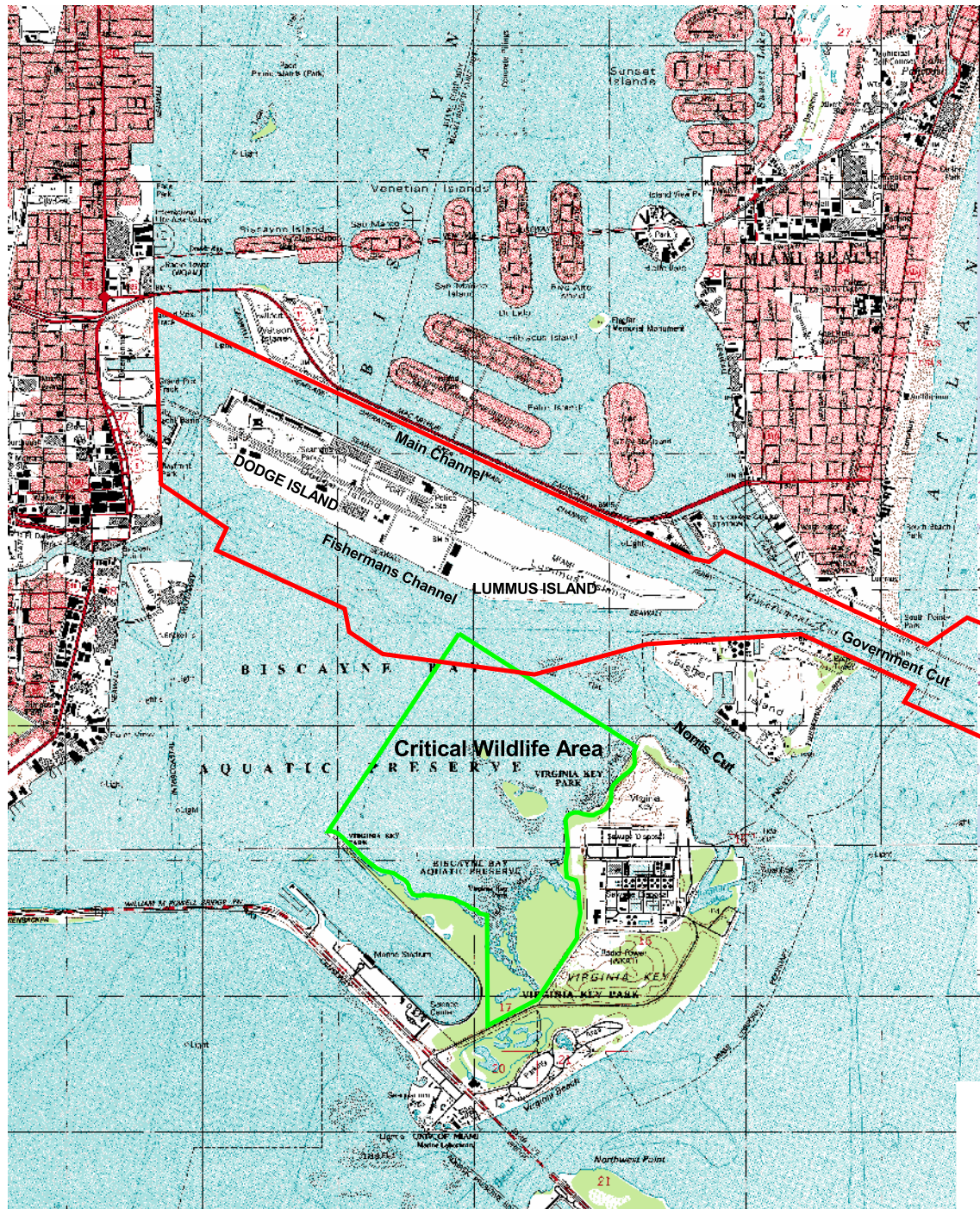
BIOLOGICAL ASSESSMENT TO THE U.S. FISH AND WILDLIFE SERVICE FOR MIAMI HARBOR NAVIGATION PROJECT GENERAL REEVALUATION REPORT

Description of the Proposed Action –

The Port of Miami requested that the U.S. Army Corps of Engineers study the feasibility of widening and deepening most of the major channels and basins within Miami Harbor. A number of alternatives were originally considered, but during efforts to reduce impacts to the environment, many were eliminated from further analysis. Three alternatives were thoroughly analyzed (two action alternatives and the “no action” alternative) in the Environmental Impact Statement. The recommended plan (Alternative 2) includes five components: (1) flaring the existing 500-foot wide entrance channel to provide an 800-foot wide entrance channel at Buoy 1, and deepening the entrance channel and widener from an existing depth of 44 feet to a depth of 52 feet; (2) widening the southern intersection of Cut-3 with Lummus Island (Fisherman’s) Channel at Buoy 15, and deepening from existing depth of 42 feet to 50 feet; (3) extending the existing Fisher Island turning basin to the north by approximately 300 feet near the west end of Cut-3, and deepening from 43 to 50 feet; (4) relocating the west end of the main channel to about 250 feet to the south (without dredging); and (5) increasing the width of Lummus Island Cut (Fisherman’s Channel) about 100 feet to the south of the existing channel, reducing the existing size of the Lummus Island (or Middle) turning basin to a diameter of 1,500 feet, and deepening from the existing 42-foot depth to 50 feet. The action alternative not selected included these five components and a sixth, involving the deepening of Dodge Island Cut and creation of another turning basin. Sand, silt, clay, soft rock, rock fragments, and loose rock will be removed via traditional dredging methods. Where hard rock is encountered, the Corps anticipates that contractors will utilize other methods, such as blasting, use of a punch-barge/pile driver, or large cutterhead equipment. Blasting will be implemented only in those areas where standard construction methods are unsuccessful. Dredged/broken substrates will be deposited at up to four locations. Some rock and coarse materials will be transported by barge and placed at an artificial reef site as mitigation for impacts to hardbottom communities. Other rock/coarse materials will be placed in a previously dredged depression in North Biscayne Bay as part of construction measures to create seagrass habitat. The balance of rock and coarse materials that cannot be utilized will be transported to the Offshore Dredged Materials Disposal Site (ODMDS). Viable sand dredged from inshore areas will be relocated and used as a sand cap for the seagrass mitigation site. The balance of sand will be placed on a permitted, upland disposal area on Virginia Key, for possible future use as beach renourishment material.

Action Area

The Port of Miami (Miami-Dade County, Florida) is one of the major port complexes along the east coast of the U.S. The Port utilizes Miami Harbor, which lies in the north side of Biscayne Bay (Figure 1), a shallow, expansive, subtropical lagoon (thirty-eight miles long, and three to nine miles wide) that extends from the City of North Miami south to the northern end of Key Largo. Average depth is six to ten feet (USACE, 1989). The Bay is bordered on the west by the mainland of peninsular Florida and



- ▭ Approximate Extent of Study Area
- ▭ Bill Sadowski Critical Wildlife Area



Location Map	
Miami Harbor	
General Reevaluation Report	
Preliminary Draft Environmental Impact Statement	
Scale: 1" = 4,000'	Drawn By: MR
Date: July, 2002	
	J00-499
	Figure 1

on the east by both the Atlantic Ocean and a series of barrier islands consisting of sand and carbonate deposits over limestone bedrock (Hoffmeister, 1974). Except for Virginia Key, the islands within and adjacent to the project area (Dodge-Lummas, Fisher, Star, Palm, and Claughton Islands, Watson Park, and the barrier island comprising Miami Beach) are completely developed. A mixture of low, medium and high-density residential areas; commercial enterprises; industrial complexes; office parks; and recreational areas characterizes land surrounding the Port of Miami waters. Specific features found to the north of the port's Main Channel include the MacArthur Causeway (Highway A1A), park/recreation and commercial facilities at Watson Island, the Terminal Island industrial area, and the U.S. Coast Guard Base at Causeway Island. Low-density residential uses are found beyond the MacArthur Causeway on Palm, Hibiscus and Star Islands. Medium and high density residential, park/recreation, commercial, and institutional land uses are found to the east of the port on Fisher Island and the southern portion of the City of Miami Beach. Located approximately one-half mile south of the port, across the waters of Biscayne Bay, is Virginia Key. Land uses found on Virginia Key include park/recreation, environmentally protected areas, and institutional and public facilities including the Miami-Dade County Virginia Key Wastewater Treatment Plant. Miami's Central Business District is found to the west of the port. Habitats within the project impact area include seagrass beds; coral reefs and other hardgrounds; sand-, silt-, and rubble-bottom habitats; and rock/rubble habitats. Other habitats in the vicinity of the project include beaches and mangroves. Adjacent to the harbor is the Biscayne Bay Aquatic Preserve, a *No Entry* zone for protection of manatees, and a Critical Wildlife Area associated with Virginia Key.

Protected Species Included in this Assessment

Of the listed and protected species under U.S. Fish and Wildlife Service (FWS) jurisdiction occurring in the action area, the Corps believes that the Florida manatee (*Trichechus manatus*) and the American crocodile (*Crocodylus acutus*) may be affected by the implementation of the navigation project and are the subject of this document. Protected/listed species that are known to occur in the area and that are under the jurisdiction of the National Marine Fisheries Service (NMFS) include the green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), Kemp's ridley turtle (*Lepidochelys kempii*), Hawksbill turtle (*Eretmochelys imbricata*), and smalltooth sawfish (*Pristis pectinata*). The Corps has initiated consultation with the NMFS concerning the effects of the proposed action on these species.

The American crocodile was listed as an endangered species under the Endangered Species Act in 1975 (40 FR 44151) and critical habitat was established for this species in 1979 (44 FR 75076). Populations are at risk due to habitat loss, direct human disturbance, alteration of habitats (including hydrology) by humans, poaching, and incidental takes during net fishing (USFWS, 1992). The American alligator (*Alligator mississippiensis*) is listed under ESA as *threatened by similarity of appearance* in order to better protect American crocodiles. The number of nests observed in surveys has doubled over the last twenty-five years (P. Moler, in Richey, 2002). However, population estimates of adults and total individuals range widely, precluding a robust determination of the status of the species within the United States. If current studies determine that natural dispersal, rather than releases by humans, is the cause of recent observations of crocodiles north of Miami-Dade County, the FWS may recommend downlisting the species to "threatened" (Richey, 2002).

The Federal government has recognized the threats to the continued existence of the Florida manatee, a subspecies of the West Indian manatee, for more than 30 years. The West Indian manatee was first listed as an endangered species in 1967 under the Endangered Species Preservation Act of 1966 (16 U.S.C. 668aa(c)) (32 FR 48:4001). The Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa(c)) continued to recognize the West Indian manatee as an endangered species (35 FR 16047), and the West Indian manatee was also among the original species listed as endangered pursuant to the Endangered Species Act of 1973. Critical habitat was designated for the manatee in 1976, and includes the project area (50 CFR 17.95). The justification for listing as endangered included impacts to the population from harvesting for flesh, oil, and skins as well as for sport, loss of coastal feeding grounds from siltation, and the volume of injuries and deaths resulting from collisions with the keels and propellers of powerboats. Manatees are also protected under the provisions of the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 *et seq.*) and have been protected by Florida law since 1892. Florida provided further protection in 1978 by passing the Florida Marine Sanctuary Act designating the state as a manatee sanctuary and providing signage and speed zones in Florida's waterways.

Species and Suitable Habitat Descriptions

American Crocodile (*Crocodylus acutus*)

There are twenty-three species of crocodilians, including eight alligatorid species (alligators and caimans), fourteen crocodylid species, and one gavialid species. Crocodilians occupy portions of all continents with appropriate habitats in the tropics, subtropics, and (for two species) temperate climatic zones. Fifteen species and two subspecies of crocodilians are protected under the Convention on International Trade in Endangered Species (CITES Appendix I).

The historic range of American crocodiles includes the U.S., Mexico, all Central American countries, many Caribbean islands, Venezuela, Colombia, Ecuador, and Peru. In the U.S., they have been observed in Florida Bay and north along coastal areas to Sanibel Island on the west coast of Florida, and north along coastal areas on the east coast to Key Biscayne.

Project Area Distribution

Recent observations have occurred at several localities on Key Biscayne (Crandon Park and Bill Baggs State Recreation Area), as well as scattered records of individual animals in Hollywood (Mazzotti, pers com) and Palm Beach, Florida, and as far north as Jupiter, Florida (Richey, 2002 and FWS, 1999).

Habitats and Habits

The American crocodile is found primarily in mangrove swamps and along low-energy mangrove-lined bays, creeks, and inland swamps (Kushlan and Mazzotti 1989). In Florida, patterns of crocodile habitat use shift seasonally. During the breeding and nesting seasons, adults outside of Key Largo and Turkey Point use the exposed shoreline of Florida Bay. Males tend to stay more inland than the females at this time (FWS, 1999). During the non-nesting season, they are found primarily in the fresh and brackish-water inland swamps, creeks, and bays, retreating further into the backcountry in fall and winter

(Kushlan and Mazzotti 1989). In a study by Kushlan and Mazzotti (1989) along northeastern Florida Bay, crocodiles were found in inland ponds and creeks (50 percent of observations), protected coves (25 percent of observations), exposed shorelines (6 percent of observations) and a small number were observed on mud flats. The high use of inland waters suggests crocodiles prefer less saline waters, using sheltered areas such as undercut banks and mangrove snags and roots that are protected from wind and wave action. Access to deep water (>1.0 m) is also an important component of preferred habitats (Mazzotti 1983).

Critical habitat for the American crocodile includes all land and water within an area encompassed by a line beginning at the easternmost tip of Turkey Point, Miami-Dade County, on the coast of Biscayne Bay; southeast along a straight line to Christmas Point at the southernmost tip of Elliott Key; southwest along a line following the shores of the Atlantic Ocean side of Old Rhodes Key, Palo Alto Key, Angelfish Key, Key Largo, Plantation Key, Lower Matecumbe Key, and Long Key, to the westernmost tip of Long Key; northwest along a straight line to the westernmost tip of Middle Cape; north along the shore of the Gulf of Mexico to the north side of the mouth of Little Sable Creek; east along a straight line to the northernmost point of Nine-Mile Pond; northeast along a straight line to the point of beginning (50 CFR 17.95).

The American crocodile is typically active from shortly before sunset to shortly after sunrise (Mazzotti 1983). During these times, crocodiles forage opportunistically; eating whatever animals they can catch. Juveniles typically eat fish, crabs, snakes, and other small invertebrates, whereas adults are known to eat fish, crabs, snakes, turtles, birds, and small mammals (FWS, 1999). American crocodiles probably feed only rarely during periods of low ambient air temperatures, since metabolic and digestive systems are slowed at lower body temperatures.

Females reach sexual maturity at about 2.25 m (Mazzotti 1983), a size reached at an age of about 10 to 13 years. It is not known at what age and size females mature. Similarly, the maximum reproductive age for either sex is not known, although it is known that captively reared crocodilians eventually fail to reproduce. As with most crocodilians, courtship and mating are stimulated by increasing ambient water and air temperatures. Reproductive behaviors peak when body temperatures reach levels necessary to sustain hormonal activity. In South Florida, temperatures sufficient to allow initiation of courtship behavior are reached by late February through March. Like all other crocodilians, the mating system of the American crocodile is polygynous; breeding males may mate with a number of females. Following courtship and mating, females search for and eventually select a nest site in which they deposit an average of about 38 elongated oval eggs. Reported clutch size ranges from 8 to 56 eggs (Kushlan and Mazzotti 1989). Although American crocodile nesting is generally considered a non-social event, communal nesting is the norm in parts of the Caribbean, southeast Cuba, and Haiti. In the U.S., several incidents of 2-clutch nests have been reported (Kushlan and Mazzotti 1989). Nest sites are typically selected where a sandy substrate exists above the normal high water level. Nesting sites include areas of well drained sands, marl, peat, and rocky spoil and may include areas such as sand/shell beaches, stream banks, and canal spoil banks that are adjacent to relatively deep water (Kushlan and Mazzotti 1989). In some instances, where sand or riverbanks are not available for nesting sites, a hole will be

dug in a pile of vegetation or marl the female has gathered. The use of mounds or holes for nesting is independent of the substrate type and may vary among years by the same female (Kushlan and Mazzotti 1989). Hatching occurs after approximately 90 days (Britton, 2002). Some parental care has been observed, and it may be critical that parents and hatchlings are left undisturbed by humans as young are emerging from nests with the assistance of adults (FWS, 1992). A complete review of crocodile biology is included in the South Florida Multi-species Recovery Plan (FWS, 1999) and will not be repeated here.

Population Trends

American crocodiles have been reported in South Florida since the arrival of the first non-native settlers. However, many records are anecdotal and many of the observations may have been confused with sympatric alligators. In addition, habitats preferred by crocodiles were remote and inaccessible by early settlers, thereby precluding reliable observations. Early 20th century population estimates of up to 2,000 crocodiles have been published (FWS, 1999), yet this is believed to be an underestimate since hunting and habitat destruction had already occurred by this time. In the late 19th and early 20th centuries many crocodiles were hunted and collected for museums and zoos. The species was also legally hunted in Florida until 1962. By the mid 1970's it is estimated that the population had been reduced to between 100 and 400 animals (Ogden, 1978a *in* FWS, 1999).

Combined, many natural and anthropogenic factors have resulted in adverse effects to the American crocodile. Compared to the historical estimates of 1,000 to 2,000 animals (Ogden, 1978a *in* FWS, 1999), populations have declined, and shifts in the nesting distribution have likely occurred. The lowest estimated population levels apparently occurred sometime during the 1960s or 70s, when Ogden estimated the Florida population of the American crocodile to be between 100 and 400 non-hatchlings.

The American crocodile population in South Florida has increased substantially over the last 20 years. P. Moler (cited in FWS, 1999) believes between 500 and 1,000 individuals (including hatchlings) persist there currently. The recent increase is best represented by changes in nesting effort. Survey data gathered with consistent effort indicate that nesting has increased from about 20 nests in the late 1970s to about 50 nests in 1997. Since female crocodiles produce only one clutch per year, it follows that the population of reproductively active females has more than doubled in the last 20 years. In addition, since at least a portion of the population's sex ratio approaches 1:1, it is likely that the male portion of the population has also increased substantially.

Florida Manatee (*Trichechus manatus*)

All manatees belong to the order Sirenia. The living sirenians consist of one species of dugong and three species of manatee. A fifth species, the Steller's sea cow, was hunted to extinction by 1768. All living sirenians are found in warm tropical and subtropical waters. The West Indian manatee was once abundant throughout the tropical and subtropical western North and South Atlantic and Caribbean waters. The Florida manatee occurs throughout the southeastern United States. However, the only year-round populations of manatees occur throughout the coastal and inland waterways of peninsular

Florida and Georgia (Hartman, 1974). During the summer months, manatees may range as far north along the East Coast of the U.S. as Rhode Island, west to Texas, and, rarely, east to the Bahamas (FWS 1996, Lefebvre et al. 1989). There are reports of occasional manatee sightings from Louisiana, southeastern Texas, and the Rio Grande River mouth (Gunter 1941, Lowery 1974).

Distribution

In Florida, manatees are commonly found from the Georgia/Florida border south through Biscayne Bay on the Atlantic coast, and from the Wakulla River south to Cape Sable on the Gulf coast (Hartman 1974, Powell and Rathbun 1984). Manatees are also found in Lake Okeechobee, throughout waterways in the Everglades, and in the Florida Keys. Low numbers of manatees in the Florida Keys has been attributed to the scarcity of fresh water (Beeler and O'Shea 1988).

In warmer months (April to November), the distribution of manatees along the east coast of Florida tends to be greater around the St. Johns River, the Banana and Indian rivers to Jupiter Inlet, and Biscayne Bay. In the winter, higher numbers of manatees are seen on the east coast at the natural warm waters of Blue Spring and near man-made warm water sources on or near the Indian River Lagoon, at Titusville, Vero Beach, Ft. Pierce, Riviera Beach, Port Everglades, Ft. Lauderdale, and throughout Biscayne Bay and nearby rivers and canals (FWS 1996). On the west coast of Florida, larger numbers of manatees are found at the Suwannee, Crystal and Homosassa rivers, Tampa Bay, Charlotte Harbor/Matlacha Pass/San Carlos Bay area, the Caloosahatchee River and Estero Bay area, the Ten Thousand Islands, and the inland waterways of the Everglades. On the west coast, manatee's winter at Crystal River, Homosassa Springs, and other warm mineral springs (Powell and Rathbun 1984, Rathbun *et al.* 1990). They also aggregate near industrial warm water outflows in Tampa Bay, the warmer waters of the Caloosahatchee and Orange rivers (from the Ft. Myers power plant), and in inland waters of the Everglades and Ten Thousand Islands. The patchy distribution of manatees throughout all their ranges is due to the distribution of suitable habitat: plentiful aquatic plants and a freshwater source.

Habits

Florida manatees are herbivores that feed opportunistically on a wide variety of submerged, floating and emergent vegetation. Shallow grass beds with ready access to deep channels are the preferred feeding areas in coastal and riverine habitats. Bengtson (1983) estimated that the annual mean consumption rate for manatees feeding in the upper St. John's River at 4% to 9% of their body weight per day depending on season. A complete review of manatee biology is included in the manatee section of the South Florida Multi-species Recovery Plan (FWS, 1999).

Preferred Habitats

Manatees occur in fresh, brackish, and salt water and move freely between environments of salinity extremes. They inhabit rivers, bays, canals, estuaries, and coastal areas that provide seagrasses and macroalgae. Freshwater sources, either natural or human-influenced/created, are especially important for manatees that spend time in estuarine and brackish waters (FWS 1996). Because they prefer water above 70 °F (21 °C), they depend on areas with access to natural springs or water effluents warmed by human activities, particularly in areas outside their native range.

Manatees often seek out quiet areas in canals, lagoons or rivers. These areas provide habitat not only for feeding, but also for resting, cavorting, mating, and calving. Manatees may be found in any waterway over 3.3 ft. (1 m) deep and connected to the coast. Deeper inshore channels and nearshore zones are often used as migratory routes (Kinnaird 1983). Although there are reports of manatees in locations as far offshore as the Dry Tortugas Islands, approximately 50 mi. (81 km) west of Key West, Florida, manatees rarely venture into deep ocean waters.

Migration Patterns

The overall geographic distribution of manatees within Florida has changed since the 1950s and 60s (Lefebvre et al 1989), and prominent shifts in seasonal distribution are also evident. Specifically, the introduction of power plants and paper mills in Texas, Louisiana, southern Georgia, and northern Florida has given manatees the opportunity to expand their winter range to areas not previously frequented (Hartman 1979). Florida manatees move into warmer waters when the water temperature drops below about 68 °F (20 °C). Before warm effluents from power plants became available in the early 1950s, the winter range of the manatee in Florida was most likely limited on its northern bounds by the Sebastian River on the east coast and Charlotte Harbor on the west coast (Moore 1951). Since that time, manatees altered their normal migration patterns, and appreciable numbers of manatees began aggregating at new sites. As new power plants became operational, more and more manatees began taking advantage of the sites even though it required traveling great distances. Among the most important of the warm-water discharges are the Florida Power and Light Company's power plants at Cape Canaveral, Fort Lauderdale, Port Everglades, Riviera Beach, and Fort Myers, and the Tampa Electric Company's Apollo Beach power plant in Tampa Bay. During cold weather, more than 200 manatees have been reported at some power plants. These anthropogenically heated aquatic habitats have allowed manatees to remain north of their historic wintering grounds. Although seemingly conducive for survival, warm-water industrial discharges alone cannot furnish suitable habitats for manatees, as they may not be associated with forage that is typically found near natural warm-water refugia of natural springs.

Population Trends

Determining exact population estimates or trends is difficult for this species. The best indicator of population trends is derived from mortality data and aerial surveys (Ackerman et al. 1992, Ackerman et al. 1995, Lefebvre et al. 1995). Increases in the number of recovered dead manatees have been interpreted as evidence of increasing mortality rates (Ackerman et al. 1992, Ackerman et al. 1995). Because manatees have low reproductive rates, these increases in mortality may lead to a decline in the population (O'Shea et al. 1988, 1992). Aerial surveys, which represent the minimum number of manatees in Florida waters (not the total population size), have been conducted for more than 20 years, and may indicate population growth. However, because survey methods were inconsistent, conclusions are tentative. O'Shea (1988) found no firm evidence of a decrease or increase between the 1970s and 1980s, even though aerial survey counts increased. Over the last decade, aerial counts have varied from 1,267 (in 1991) to 3,276 (in 2001) (FMRI 2002). The mean number observed during all counts (January, February, and/or March of all years since 1991) is 2,027 (std dev = 512).

Mortality

Human activities have likely affected manatees by eliminating or modifying suitable habitat; causing alteration of, or limiting access to historic migratory routes; and killing or injuring individuals through incidental or negligent activities. To understand manatee mortality trends in Florida, Ackerman et al. (1995) evaluated the number of recovered carcasses between 1974 and 1992 and categorized the causes of death. The number of manatees killed in collisions with watercraft increased each year by 9.3%. The number of manatees killed in collisions with watercraft each year correlated with the total number of pleasure and commercial watercraft registered in Florida (Ackerman et al. 1995). Other deaths or injuries were incurred due to flood-control structures and navigational locks, entanglement in fishing line, entrapment in culverts, and poaching, which together accounted for 162 known mortalities between 1974 and 1993 (FMRI 2002a).

Table 2 Manatee deaths in Florida (statewide) from 1974 through 2001 (source: FMRI)

Year	Watercraft	Flood Gate/ Canal Lock	Other Human	Perinatal	Cold Stress	Natural	Undetermined	Unrecovered	Total
1974	3	0	2	0	0	0	2	0	7
1975	6	1	1	7	0	1	10	3	29
1976	10	4	0	14	0	2	22	10	62
1977	13	6	5	9	0	1	64	16	114
1978	21	9	1	10	0	3	34	6	84
1979	24	8	9	9	0	4	18	5	77
1980	16	8	2	13	0	5	15	4	63
1981	24	2	4	13	0	9	62	2	116
1982	20	3	1	14	0	41	29	6	114
1983	15	7	5	18	0	6	28	2	81
1984	34	3	1	25	0	24	40	1	128
1985	33	3	3	23	0	19	32	6	119
1986	33	3	1	27	12	1	39	6	122
1987	39	5	2	30	6	10	22	0	114
1988	43	7	4	30	9	15	23	2	133
1989	50	3	5	38	14	18	39	1	168
1990	47	3	4	44	46	21	40	1	206
1991	53	9	6	53	1	13	39	0	174
1992	38	5	6	48	0	20	45	1	163
1993	35	5	6	39	2	22	34	2	145
1994	49	16	5	46	4	33	37	3	193
1995	42	8	5	56	0	35	53	2	201
1996	60	10	0	61	17	101	154	12	415
1997	54	8	8	61	4	42	61	4	242
1998	66	9	6	53	9	12	72	4	231
1999	82	15	8	53	5	37	69	0	269
2000	78	8	8	58	14	37	62	8	273
2001	81	1	7	61	32	33	108	2	325

Of interest is the increase in the number of perinatal deaths. The frequency of perinatal deaths (stillborn and newborn calves) has been consistently high over the past 5 years. The cause of the increase in perinatal deaths is uncertain, but may result from a combination of factors that includes pollution, disease, or environmental change (Marine Mammal Commission 1992). It may also result from the increase in collisions between manatees and watercraft because some newborn calves may die when their mothers are killed or seriously injured by boat collisions, when they become separated from their mothers while dodging boat traffic, or when stress from vessel noise or traffic induces premature births (Marine Mammal Commission 1992).

The greatest present threat to manatees is the high rate of manatee mortalities caused by watercraft collisions. Between 1974 and 1997, there were 3,270 known manatee mortalities in Florida. Of these, 749 were watercraft-related. Since 1974, an average of 31 manatees have died from watercraft-related injuries each year. Between 1983 and 1993, manatee mortalities resulting from collisions with watercraft reached record levels (DEP 1994). Between 1986 and 1992, watercraft collisions

accounted for 37.3% of all manatee deaths where the cause of death could be determined (Ackerman *et al.* 1995).

The significance of manatee mortalities related to watercraft appears to be the result of dramatic increases in vessel traffic (O'Shea *et al.* 1985). Ackerman *et al.* (1995) showed a strong correlation between the increase in recorded manatee mortality and increasing boat registrations. In 1960, there were approximately 100,000 registered boats in Florida; by 1990, there were more than 700,000 registered vessels in Florida (Marine Mammal Commission 1992, Wright *et al.* 1995). Approximately 97 percent of these boats are registered for recreational use. The most abundant number of registered boats is in the 16-foot to 26-foot size class. Watercraft-related mortalities were most significant in the southwest and northeast regions of Florida; deaths from watercraft increased from 11 to 25 percent in southwestern Florida. In all of the counties that had high watercraft-related manatee deaths, high numbers of watercraft were combined with high seasonal abundance of manatees (Ackerman *et al.* 1995).

Approximately twice as many manatees died from impacts suffered during collisions with watercraft than from propeller cuts; this has been a consistent trend over the last several years. Medium or large-sized boats cause most lethal propeller wounds, while impact injuries are caused by fast, small to medium-sized boats (Wright *et al.* 1992). The Florida Marine Research Institute (FMIR) conducts carcass recovery and necropsy activities throughout the state to attempt to assess the cause of death for each carcass recovered. Dr.

Designated Critical Habitat for Species Included in this Assessment

American Crocodile (*Crocodylus acutus*)

There have been at least two observations of crocodiles at or near Virginia Key (FWC, pers com; Mazzotti, pers com), however designated critical habitat for this species does not include the island (U.S. Fish and Wildlife Service 1999). Crocodiles are more frequently observed in Bill Baggs/Cape Florida State Park on Key Biscayne (G. Milano, Department of Environmental Resource Management-Dade County, 2002).

Florida Manatee (*Trichechus manatus*)

Critical habitat was designated for the manatee in 1976, although no specific primary or secondary constituent elements were included in the designation (50 CFR 17.95). Critical habitat for the manatee identifies specific areas occupied by the manatee, which have those physical or biological features essential to the conservation of the manatee and/or may require special management considerations.

Project Area Specific Information for Species Included in this Assessment

American Crocodile (*Crocodylus acutus*)

Local Distribution and Status

The current distribution of the American crocodile is limited to extreme South Florida, including coastal areas of Miami-Dade, Monroe, Collier, and Lee counties. In Biscayne Bay, crocodiles have been observed as far north as Crandon Park, Bill Baggs Cape Florida SRA, and Snapper Creek (FWS,

1999). Occasional sightings are still reported farther north on the east coast, and there are also records from Broward County, along the entire length of Biscayne Bay; a few isolated crocodiles still survive in remnant mangrove habitats there.

While there are no published records specifically citing American crocodiles utilizing the waters of the Port of Miami, it is possible that they utilize the waters of the Bill Sadowski Critical Wildlife Area north of Virginia Key for foraging. Crocodiles have been recorded in the vicinity of Virginia Key and nesting on Key Biscayne (Crandon Park Marina and Bill Baggs State Recreation Area).

Florida Manatee (*Trichechus manatus*)

Local Distribution and Status

Historical records regarding manatees in South Florida are sparse. Manatees are mentioned in documents that are dated as early as the mid 1800's and early 1900's (O'Shea 1988). Moore (1951) indicated that manatees commonly used the New River and the Miami River. He also noted a 1943 anecdotal observation of more than 100 manatees killed during the deepening of the Miami River Channel and a reference to 195 manatees aggregating at the Miami power plant discharge in 1956 (Mezich 2001). In general, the rivers, creeks and canals that open into Northern Biscayne Bay were locations noted for their manatee abundance. These remain important habitats, particularly on a seasonal basis (Figures 2 and 3). In freshwater environments in Dade County (upper reaches of canals), manatees are feeding primarily on the exotic *Hydrilla verticillata*. During cooler weather, manatees feed on extensive meadows of seagrasses in many parts of Biscayne Bay.

Local Mortality

The causes for manatee deaths in Dade County are varied (Table 3; Figure 4). The highest number of manatee deaths in Dade County result from water control structures. Floodgates often have qualities that are attractive to manatees. Freshwater is often available at floodgates, and is typically slightly warmer than the ambient water. An example of this situation is the floodgate on the Little River in Dade County. This site is known to attract manatees in winter during mild weather. This location has a 1-degree Celsius higher water temperature than surrounding areas and freshwater is available (Deutsch 2000). Also, freshwater vegetation is often washed down from upriver and made available when the gates are opened. Figure 5 demonstrates the location of water control structures near the project area. The second most frequent cause of manatee deaths in Miami-Dade County is boat-related injuries.

No deaths related to cold stress have been reported. Miami Harbor is well within the historic range for the Florida manatee described by Moore (1951), and therefore water temperatures likely seldom reach stressing levels for extended periods of time. Also, power plants located to the north in Broward County have likely ameliorated cold-related stress.

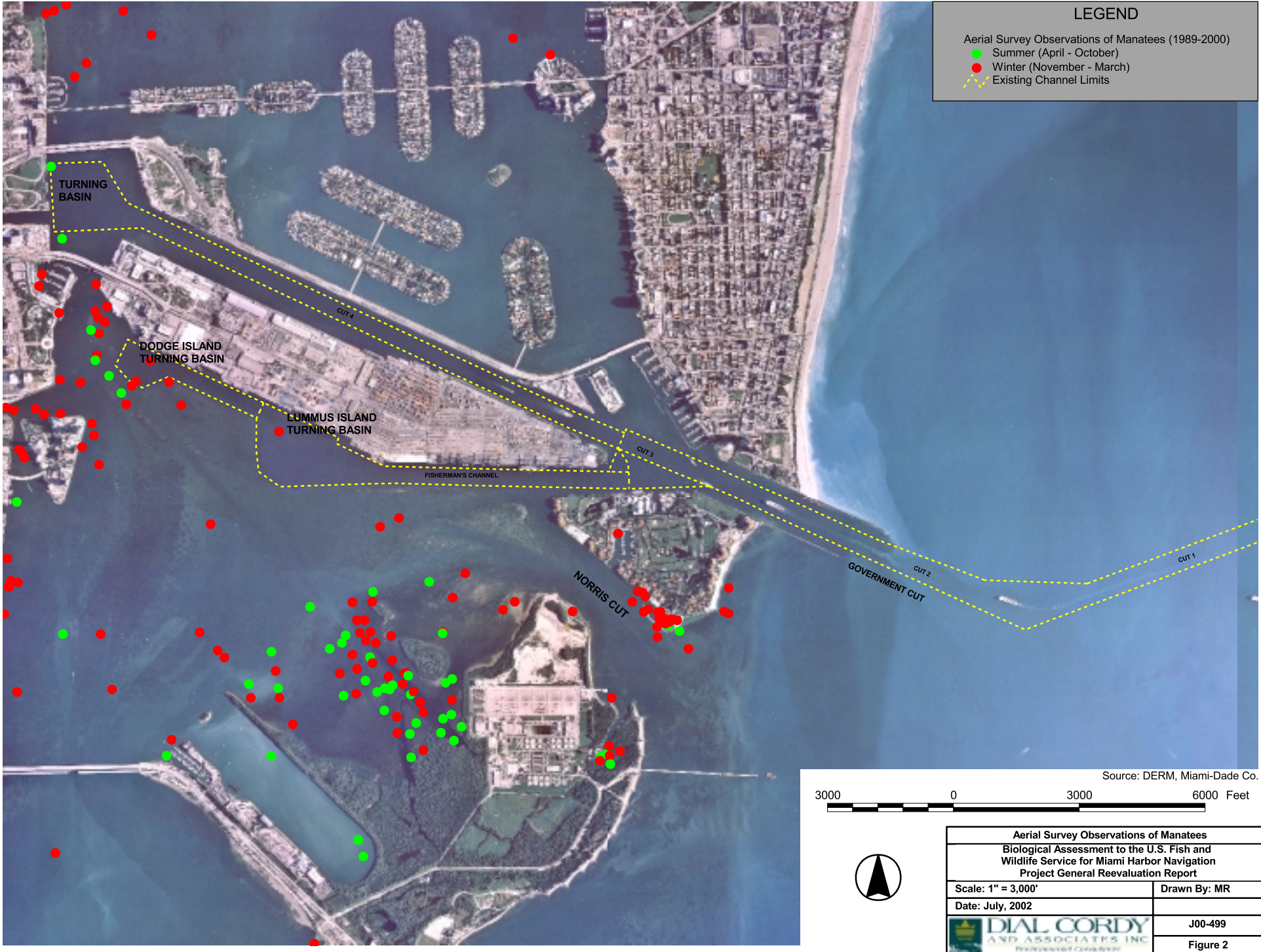
LEGEND

Aerial Survey Observations of Manatees (1989-2000)

● Summer (April - October)


● Winter (November - March)

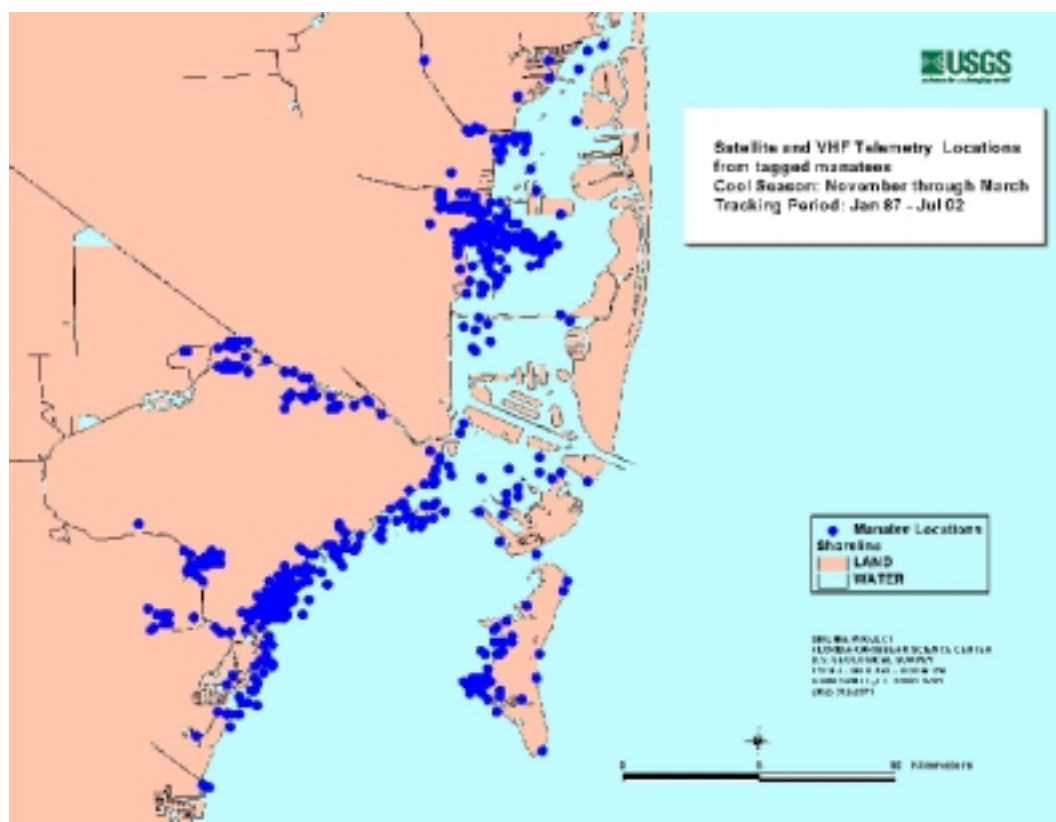
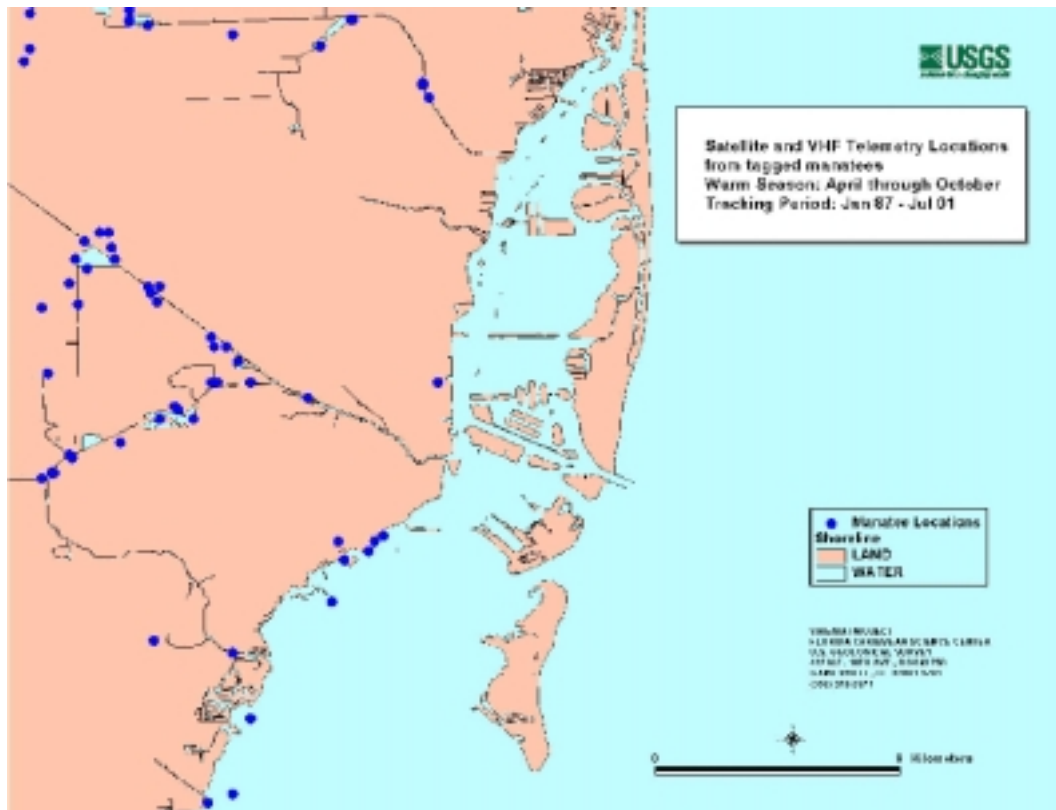
--- Existing Channel Limits



Source: DERM, Miami-Dade Co.



Aerial Survey Observations of Manatees	
Biological Assessment to the U.S. Fish and Wildlife Service for Miami Harbor Navigation Project General Reevaluation Report	
Scale: 1" = 3,000'	Drawn By: MR
Date: July, 2002	
 DIAL CORDY AND ASSOCIATES INC. <small>Professional Consultants</small>	J00-499
	Figure 2



Manatee Locations Based on Telemetry
Biological Assessment to the U.S. Fish and Wildlife Service for Miami Harbor Navigation Project General Reevaluation Report

Scale: 1" = 3,000'

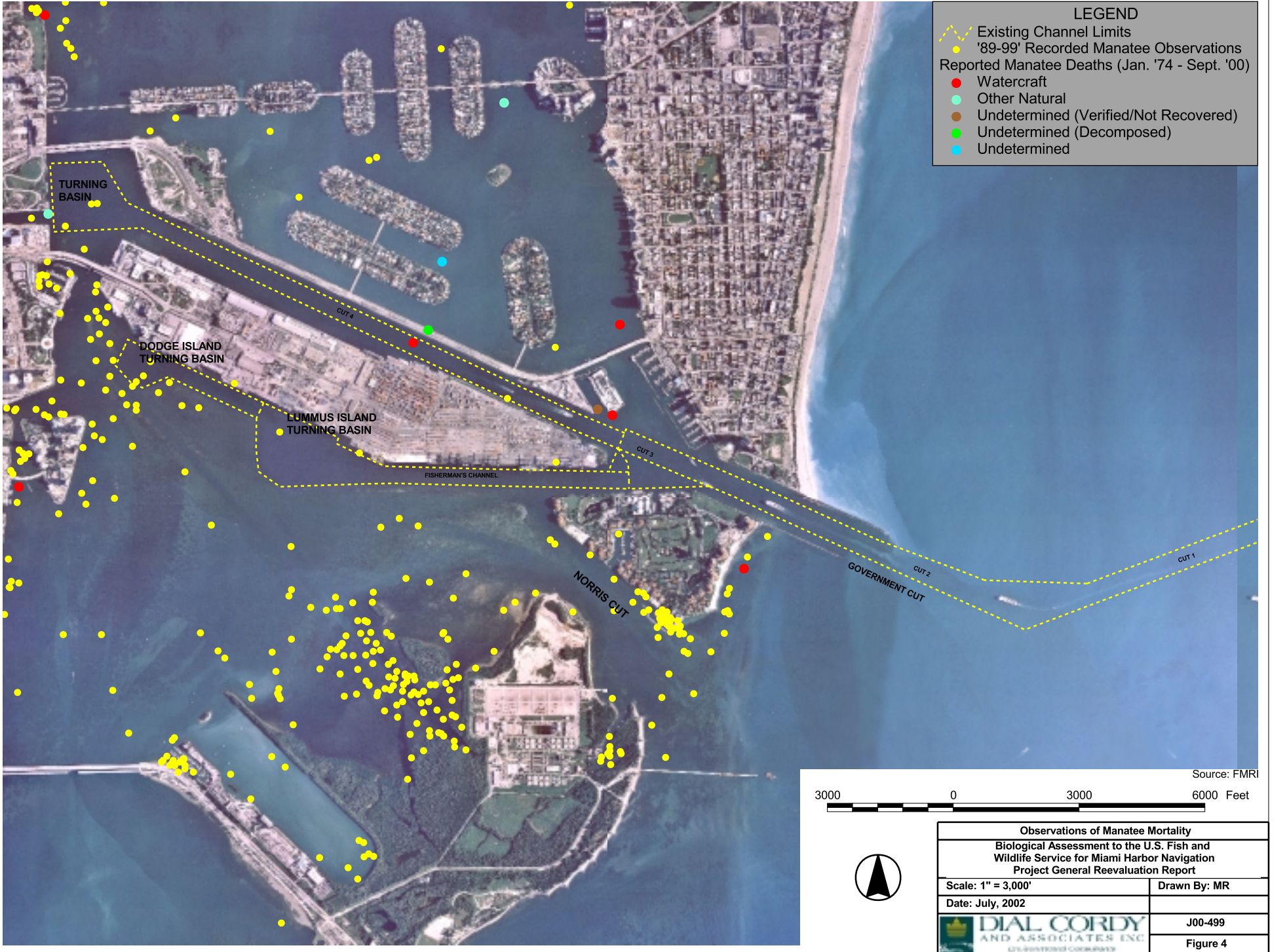
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Date: July, 2002



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Figure 3



LEGEND

- Existing Channel Limits
- '89-99' Recorded Manatee Observations
- Reported Manatee Deaths (Jan. '74 - Sept. '00)
 - Watercraft
 - Other Natural
 - Undetermined (Verified/Not Recovered)
 - Undetermined (Decomposed)
 - Undetermined

Source: FMRI




Observations of Manatee Mortality	
Biological Assessment to the U.S. Fish and Wildlife Service for Miami Harbor Navigation Project General Reevaluation Report	
Scale: 1" = 3,000'	Drawn By: MR
Date: July, 2002	
 DIAL CORDY AND ASSOCIATES INC. <small>ENVIRONMENTAL CONSULTANTS</small>	J00-499
	Figure 4

Table #3 Manatee deaths in Miami-Dade County from 1974 through 2001 (source: FMRI)

Year	Watercraft	Gate/Lock	Human, Other	Perinatal	Cold stress	Natural	Undetermined	Total
1974	2	0	0	0	0	0	0	2
1975	1	1	0	1	0	0	1	4
1976	2	4	0	0	0	1	8	15
1977	1	5	2	2	0	0	2	12
1978	2	8	0	0	0	0	2	12
1979	1	5	2	0	0	0	1	9
1980	0	2	0	0	0	0	0	2
1981	1	0	2	0	0	0	2	5
1982	0	2	0	0	0	0	2	4
1983	0	1	4	1	0	0	1	7
1984	1	0	0	0	0	0	0	1
1985	1	1	0	2	0	0	0	4
1986	1	0	1	0	0	0	0	2
1987	4	2	0	1	0	0	1	8
1988	1	6	0	0	0	1	1	9
1989	3	0	0	0	0	0	0	3
1990	1	1	0	0	0	0	2	4
1991	0	1	0	2	0	2	2	7
1992	4	1	1	1	0	1	2	10
1993	0	2	2	0	0	0	1	5
1994	1	4	3	1	0	1	1	11
1995	2	3	2	0	0	3	4	14
1996	0	3	0	1	0	0	3	7
1997	5	5	1	2	0	0	1	14
1998	2	3	1	0	0	0	3	9
1999	1	5	3	0	0	2	1	12
2000	2	2	2	0	0	0	2	8
2001	5	0	2	2	0	0	2	11
Totals	26	30	17	9	0	9	24	115

Protective Measures Taken in the Project Area Separate from Conservation Measures the Corps will Undertake as Part of the Proposed Action

Miami-Dade County

Miami-Dade County is one of 13 Florida counties required to have a manatee protection plan (MPP) developed under the Local Government Comprehensive Planning and Land Development Regulation Act (LGCPALDRA) of 1985. The LGCPALDRA requires these plans include speed and no entry zones, boat facility siting policies and other measures to protect manatees. Miami-Dade County has prepared a plan, submitted it to the State, through the Florida Fish and Wildlife Conservation Commission, and to the Federal government through the US Fish and Wildlife Service. As of November 2001, both the state nor the USFWS had approved the Miami-Dade County plan (USFWS 2001). The following discussions of speed zones, boat facility siting policies and other protective measures are taken directly from the Miami-Dade Manatee Protection Plan (Dade County, 1995).

Speed & No Entry Zones

In 1979, the Florida Department of Natural Resources designated the Black Creek area including Black Point Marina (south of the project area) as a manatee sanctuary. The “Idle Speed No Wake” zone associated with this sanctuary extends from the Black Creek entrance channel in Biscayne Bay to the salinity control structure on Black Creek and Goulds Canal, and includes all tidal canals in the vicinity. Prior to late 1991, there were no other speed zones in Dade County established for manatee protection, although several other areas were regulated for boating safety. In November 1991, the Florida Governor and Cabinet approved a state rule establishing many additional vessel speed restrictions for manatee protection. Figure 6 denotes all current speed zones and manatee protection areas in Dade County.

Boating facility Siting Policies

The LGCPALDRA requires “manatee” counties to prepare policies concerning the siting of boating facilities. Dade County has include Marine Facility Siting Criteria in their MPP.

Designation of Essential Habitat for Manatees within the County

Dade County has identified areas to be designated as essential habitat: seagrass beds – specifically those in Dumfoundling Bay and Biscayne Bay between the 79th Street and the Julia Tuttle causeways, between the Port of Miami and Rickenbacker Causeway, in the Chicken Key area and in the area of the Black Creek channel. Additional habitat areas listed for protection under the Dade County MPP include sources of freshwater; warm water refuges (although none currently operate in the boundaries of Dade county); aggregation areas (including Sky Lake, Biscayne Canal near the Miami Shores Country Club golf course, Little River west of Biscayne Boulevard, northwest Virginia Key, upstream Miami River including Palmer Lake, upstream Coral Gables Waterway, and Black Point marina basin) and manatee travel corridors.

Scientific Research on Manatees

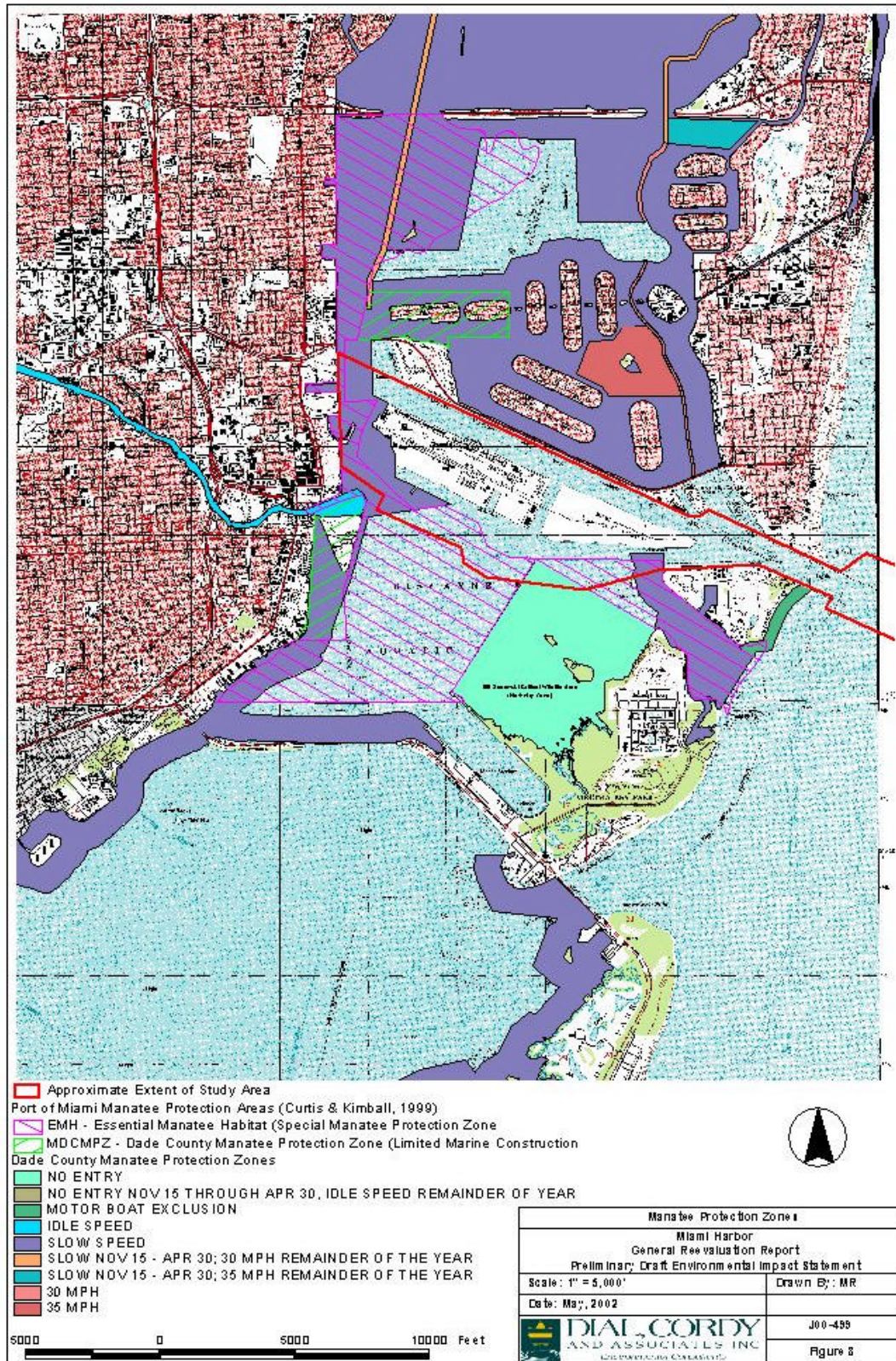
Regulations developed under the ESA allow for the taking of ESA-listed manatees for the purposes of scientific research. In addition, the ESA also allows for the taking of listed species by states through cooperative agreements developed per section 6 of the ESA. Prior to issuance of these authorizations for taking, the proposal must be reviewed for compliance with section 7 of the ESA. Permits to conduct scientific research on manatees are issued by the FWS’ headquarters in Arlington, Virginia (Jim Valade, USFWS – Jacksonville, 2002 pers.com). Research activities currently conducted under permit from FWS in the action area include:

- Photo identification study of manatees by the USGS-Sirenia project.
- Carcass recovery and necropsy activities conducted by the State of Florida through the Florida Marine Research Institute’s Marine Mammal Pathology Laboratory.

Other consultations of Federal actions in the area to date

The Corps has been working with the citizens of Dade County since 1902 on improving and maintaining the Port of Miami (USACE 2002). The following table lists the improvements authorized by Congress. None of the projects authorized by Congress through 1968 were required to consult under the ESA.

Figure #6 – Manatee Protection Zones in Dade County



ACTS	WORK AUTHORIZED	DOCUMENTS
13 June 1902	Channel (Government Cut) 18 feet deep across peninsula and north jetty	H. Doc.662/56/1 & A.R. for 1900 p.1987
2 Mar 1907	South Jetty and channel 100 feet wide.	Specified in Act
25 June 1912	Channel 20 feet deep by 300 feet wide and extension of jetties.	H. Doc. 554/62/2
3 Mar 1925	Channel 25 feet deep at entrance and 25 feet deep by 200 feet across Biscayne Bay	H. Doc. 516/67/4
3 Jul 1930	Channel 300 feet wide across Biscayne Bay and enlarging municipal turning basin.	R&H Comm. Doc. 15/71/2
30 Aug 1935	Depth of 30 feet to and in turning basin.	S. Comm. Print 73.2
26 Aug 1937	Widen turning basin 200 feet on south side.	R&H. C. Doc. 86/74/2
2 Mar 1945	Virginia Key Improvement (De-authorized)	S. Doc. 251/79/2
2 Mar 1945	Consolidation of Miami River and Miami Harbor projects; widening at mouth of Miami River (De-authorized); a channel from the mouth of the river to the Intracoastal Waterway (De-authorized); thence a channel from the Intracoastal Waterway to Government Cut (De-authorized); and a channel from Miami River to harbor of refuge in Palmer Lake (De-authorized).	H. Doc. 91/79/1
14 Jul 1960	Channel 400 feet wide across Biscayne Bay; enlarge turning basin 300 feet on south and northeasterly sides; dredge turning basin on north side Fisher Island; de-authorize Virginia Key development.	S. Doc. 71/85/2
13 Aug 1968	Enlarging the existing entrance channel to 38-foot depth and 500-foot width from the ocean to the existing beach line; deepening the existing 400-foot wide channel across Biscayne Bay to 36 feet; and deepening the existing turning basin at Biscayne Boulevard terminal and Fisher Island to 36 feet.	S. Doc. 93/90/2
17 Nov 1986	De-authorized the widening at the mouth of Miami River to existing project widths; and the channels from the mouth of Miami River to the turning basin, to Government Cut, and to a harbor of refuge in Palmer Lake.	Public Law 99-662

28 Nov 1990	Deepening the existing Outer Bar Cut, Bar Cut, and Govt Cut to a depth of 44 ft.; Enlarging Fishermans Channel, south of Lummus Island, to a depth of 42 ft. and a width of 400 ft.; and Constructing a 1600 ft. diameter Turning Basin near the west end of Lummus Island to a depth of 42 ft.	Public Law 101-640 11/28/90
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The Corps is also working with Miami-Dade County on an environmental restoration project on Virginia Key, located to the south of the Port. The FWS issued a biological opinion on the proposed Virginia Key project on May 17, 2002 stating "... the Service anticipates that the responses of sea turtles to the proposed action will be minimal, or positive."

Another action, the Lummus Island Turning Basin deepening project, is a project with similar risks as the proposed project, but on a much smaller scale (only one inshore dredge area) and includes precautions similar to those proposed for the Miami Harbor deepening/widening project. The Corps re-initiated consultation with FWS on March 25, 2002 and the Service concluded consultation with the Corps on the project on June 19, 2002 concurring with the Corps finding that the Lummus Island Turning Basin deepening may affect, but will not adversely affect listed species under FWS jurisdiction in the action area.

Effects of the Proposed Action

Direct Effects

The highest potential to directly effect manatees and crocodiles may be the use of explosives to remove areas of rock within channels. Both the pressure and noise associated with blasting can injure or kill marine organisms, depending on the distance from the discharge (Keevin and Hempen, 1997).

American Crocodile

To date, there has not been a single comprehensive study to determine the effects of underwater explosions on reptiles that defines the relationship between distance/pressure and mortality or damage (Keevin and Hempen, 1997). However, there have been studies, which demonstrate that sea turtles are killed and injured by underwater explosions (Keevin and Hempen, 1997). Crocodiles are shy, un-aggressive animals, and as such, the Corps believes that it is very unlikely that a crocodile will be seen in or near the project area during construction. However, due to the proximity of areas of recorded sightings of crocodiles, we are including the American crocodile in the assessment of effects.

Crocodiles possess integumentary sensory organs (ISO). At this time, there is little information documented about the purpose of these organs, however, some research has hinted that the purpose of these ISOs includes detecting pressure changes, sensory role in detecting underwater prey and possibly in detecting changes in salinity. The Corps plans to protect crocodiles in the same manner as manatees and other listed and protected species in the action area. Details concerning our protection methods are provided below.

Florida Manatee

The effects of noise and pressure on manatees, associated with confined underwater blasting have not been documented. After discussions with Dr. Darlene Kettin of the Woods-Hole Oceanographic Institute, the Corps has determined that manatees would be impacted similar to dolphins, for which some published data do exist.

Blasting

To achieve the deepening of the Port of Miami from the existing depth of -42 feet to project depth of -50 feet, pretreatment of the rock areas may be required. Blasting is anticipated to be required for some or all of the deepening of the channel inside of the entrance jetties, where standard construction methods are unsuccessful. The total volume to be removed in these areas is up to 2.3 million cubic yards. The work may be completed in the following manner:

Contour dredging with either bucket, hydraulic or excavator dredges to remove material that can be dredged conventionally and determine what areas require blasting.

Pre-treating (blasting) the remaining above grade rock, drilling and blasting the "Site Specific" areas where rock could not be conventionally removed by the dredges.

Excavating with bucket, hydraulic or excavator dredges to remove the pre-treated rock areas to grade.

All drilling and blasting will be conducted in strict accordance with local, state and federal safety procedures. Marine Wildlife Protection, Protection of Existing Structures, and Blasting Programs coordinated with federal and state agencies.

Based upon industry standards and USACE, Safety & Health Regulations, the blasting program may consist of the following:

The weight of explosives to be used in each blast will be limited to the lowest poundage (~90 lbs. or less) of explosives that can adequately break the rock. The blasting would consist of up to 3 blasts per day, preparing for removal of approximately 1500 cubic yards per blast. This equates to about 520 blast days to complete the project (based on an assumption of one drillboat, and assuming that the entire project area inside the jetties will require blasting).

The following safety conditions are standard in conducting underwater blasting:

- Drill patterns are restricted to a minimum of 8 ft separation from a loaded hole.
- Hours of blasting are restricted from 2 hours after sunrise to 1 hour before sunset to allow for adequate observation of the project area for protected species.
- Selection of explosive products and their practical application method must address vibration and air blast (overpressure) control for protection of existing structures and marine wildlife.
- Loaded blast holes will be individually delayed to reduce the maximum pounds per delay at point detonation, which in turn will reduce the mortality radius.

- The blast design will consider matching the energy in the “work effort” of the borehole to the rock mass or target for minimizing excess energy vented into the water column or hydraulic shock.

Because of the potential duration of the blasting and the proximity of the blasting to a Critical Wildlife Area, a number of issues will need to be addressed. One of the key issues is the extent of a safety radius for the protection of marine wildlife. This is the distance from the blast site which any protected species must be in order to commence blasting operations. Ideally the safety radius is large enough to offer a wide buffer of protection for marine animals while still remaining small enough that the area can be intensely surveyed

There are a number of methods that can be used to calculate a safety radius. Little published data exists for actual measurements of sub aqueous blasts confined to a rock layer and their impacts to marine mammals or turtles. There is some information on the impacts to fish from similar blasts. Both literature searches and actual observations from similar blasting events will be used as a guide in establishing a safety radius that affords the best protection from lethal harm to marine wildlife. The following will be considered in establishing the radius:

The U.S. Navy Dive Manual and the FFWCC Endangered Species Watch Manual the safety formula for an uncontrolled blast suspended in the water column, which is as follows:

$R = 260 (\text{cube root } w)$

R = Safety radius

W = Weight of explosives

This formula is a conservative for the blasting being done in the Port of Miami since the blast will be confined within the rock and not suspended in the water column.

The FFWCC Endangered Species Watch Manual designation that an extra 1000 ft buffer is required to afford animals an added measure of safety.

Utilizing data from rock-contained blasts such as those at Atlantic Dry Dock and Wilmington, North Carolina, the Corps has been able to estimate potential effects on protected species. These data can be correlated to the biological opinion issued on October 10, 2000 by NMFS for the incidental taking of listed marine mammals for the explosive shock testing of the USS Winston Churchill (DDG-81) (66 FR 22450) concerning blasting impacts to marine mammals. The data references in the Federal Register data indicates that impacts from explosives can produce lethal and non-lethal injury as well as incidental harassment. The pressure wave from the blast is the most causative factor in injuries because it affects the air cavities in the lungs & intestines. The extent of lethal effects are proportional to the animal's mass, i.e., the smaller the animal, the more lethal the effects; therefore all data is based on the lowest possible affected mammal weight (infant dolphin). Non-lethal injuries include tympanic membrane (TM) rupture; however, given that dolphin & manatee behavior rely heavily on sound, the non-lethal

nature of such an injury is questionable in the long-term. For that reason, it is important to use a limit where no non-lethal (TM) damage occurs. Based on the EPA test data, the level of pressure impulse where no lethal and no non-lethal injuries occur is reported to be five (5) psi-msec.

The degradation of the pressure wave

George Young (1991) noted the following limitations of the cube root method:

Doubling the weight of an explosive charge does not double the effects. Phenomena at a distance, such as the direct shock wave, scale according to the cube root of the charge weight. For example, if the peak pressure in the underwater shock wave from a 1-pound explosion is 1000 pounds per square inch at a distance of 15 feet, it is necessary to increase the charge weight to approximately 8 pounds in order to double the peak pressure at the same distance. (The cube root of eight is two.)

Effects on marine life are usually caused by the shock wave. At close-in distances, cube root scaling is generally valid. For example, the range at which lobster have 90 percent survivability is 86 feet from a 100-pound charge and double that range (172 feet) from an 800-pound charge.

As the wave travels through the water, it reflects repeatedly from the surface and seabed and loses energy becoming a relatively weak pressure pulse. At distances of a few miles, it resembles a brief acoustic signal. Therefore, shock wave effects at a distance may not follow simple cube root scaling but may decline at a faster rate. For example, the survival of swim bladder fish does not obey cube root scaling because it depends on the interaction of both the direct and reflected shock waves. In some cases, cube root scaling may be used to provide an upper limit in the absence of data for a specific effect.

More recent studies by Finneran *et. al.* (2000), showing that temporary and permanent auditory threshold shifts in marine mammals were used to evaluate explosion impacts. Due to the fact that marine mammals are highly acoustic, such impacts in behavior should be taken into account when assessing harmful impacts. While many of these impacts are not lethal and this study has shown that the impacts tend not to be cumulative, significant changes in behavior could constitute a “take” under the Marine Mammal Protection Act (MMPA).

A dual criteria for marine mammal acoustic harassment has also been developed for explosive-generated signals. Noise levels that fall between the 5 psi-msec to a distance where a noise level of 180 dB (3 psi), while outside any physical damage range, can be considered to fall within the incidental harassment zone.

Conservation Measures

Construction

The Corps will incorporate the standard manatee protection construction conditions into our plans and

specifications for this project. These standard conditions are:

1. The contractor instructs all personnel associated with the project of the potential presence of manatees and the need to avoid collisions with manatees. All construction personnel are responsible for observing water-related activities for the presence of manatee(s), and shall implement appropriate precautions to ensure protection of the manatee(s).
2. All construction personnel are advised that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the Marine Mammal Protection Act of 1972, the Endangered Species Act of 1973, and the Florida Manatee Sanctuary Act. The permittee and/or contractor may be held responsible for any manatee harmed, harassed, or killed as a result of construction activities.
3. Prior to commencement of construction, the prime contractor involved in the construction activities shall construct and display at least two temporary signs (placard) concerning manatees. For all vessels, a temporary sign (at least 8 1/2" x 11") reading "Manatee Habitat/Idle Speed In Construction Area" will be placed in a prominent location visible to employees operating the vessels. In the absence of a vessel, a temporary sign (at least 2' x 2') reading "Warning: Manatee Habitat" will be posted in a location prominently visible to land based, water-related construction crews.

A second temporary sign (at least 8 1/2" x 11") reading "Warning, Manatee Habitat: Operation of any equipment closer than 50 feet to a manatee shall necessitate immediate shutdown of that equipment. Any collision with and/or injury to a manatee shall be reported immediately to the Florida Marine Patrol at 1-800-DIAL-FMP" will be located prominently adjacent to the displayed issued construction permit. Temporary notices are to be removed by the permittee upon completion of construction.

4. Siltation barriers are properly secured so that manatees cannot become entangled, and are monitored at least daily to avoid manatee entrapment. Barriers must not block manatee entry to or exit from essential habitat.
5. All vessels associated with the project operate at "idle speed/no wake" at all times while in the construction area and while in waters where the draft of the vessel provides less than a four foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.
6. If manatees are seen within 100 yards of the active daily construction/dredging operation, all appropriate precautions shall be implemented to ensure protection of the manatee. These precautions shall include the operation of all moving equipment no closer than 50 feet of a manatee. Operation of any equipment closer than 50 feet to a manatee shall necessitate immediate shutdown of that equipment.
7. Any collision with and/or injury to a manatee shall be reported immediately to the Florida

Marine Patrol (1-800-DIALFMP) and to the Florida Department of Protection, Office of Protected Species Management at (904)922-4330.

8. The contractor maintains a log detailing sightings, collisions, or injuries to manatees should they occur during the contract period. A report summarizing incidents and sightings shall be submitted to the Florida Department of Protection, Office of Protected Species Management, Mail Station 245, 3900 Commonwealth Boulevard, Tallahassee, Florida 32399 and to the U.S. Fish and Wildlife Service, 3100 University Boulevard, Jacksonville, FL 32216. This report must be submitted annually or following the completion of the project if the contract period is less than a year.

Blasting

It is crucial to balance the demands of the blasting operations with the overall safety of the species. A radius that is excessively large will result in significant delays that prolong the blasting, construction, traffic and overall disturbance to the area. A radius that is too small puts the animals at too great of a risk should one go undetected by the observers and move into the blast area. Because of these factors, the goal is to establish the smallest radius possible without compromising animal safety and provide adequate observer coverage for whatever radius is agreed upon.

Aerial reconnaissance, where feasible, is critical to support the safety radius selected in addition to boat-based and land support reconnaissance. Additionally, an observer will be placed on the drill barge for the best view of the actual blast zone and to be in direct contact with the blaster in charge.

Prior to implementing a blasting program a Test Blast Program will be completed. The purpose of the Test Blast Program is to demonstrate and/or confirm the following:

- Drill Boat Capabilities and Production Rates
- Ideal Drill Pattern for Typical Boreholes
- Acceptable Rock Breakage for Excavation
- Tolerable Vibration Level Emitted
- Directional Vibration
- Calibration of the Environment

The Test Blast Program begins with a single range of individually delayed holes and progresses up to the maximum production blast intended for use. Each Test Blast is designed to establish limits of vibration and airblast overpressure, with acceptable rock breakage for excavation. The final test event simulates the maximum explosive detonation as to size, overlying water depth, charge configuration, charge separation, initiation methods, and loading conditions anticipated for the typical production blast.

The results of the Test Blast Program will be formatted in a regression analysis with other pertinent information and conclusions reached. This will be the basis for developing a completely engineered procedure for Blasting Plan. During the testing the following data will be used to develop a regression

analysis:

- Distance
- Pounds Per Delay
- Peak Particle Velocities (TVL)
- Frequencies (TVL)
- Peak Vector Sum
- Air Blast, Overpressure

Other Rock Removal Options

The Corps investigated methods to remove the rock in the Port of Miami without blasting using a punchbarge. It was determined that the punchbarge, which would work for 12-hour periods, strikes the rock below approximately once every 30-seconds. This constant pounding would serve to disrupt manatee behavior in the area, as well as impact other marine animals in the area. Using the punchbarge will also extend the length of the project temporally, thus increasing any potential impacts to all fish and wildlife resources in the area.

The Corps believes that blasting is actually the least environmentally impactful method for removing the rock in the Port. Each blast will last no longer than 25 seconds in duration, and may even be as short as 2 seconds, and will be spaced out twelve hours apart. Additionally, the blasts are confined in the rock substrate. Boreholes are drilled into the rock below, the blasting charge is set and then the chain of explosives is detonated. Because the blasts are confined within the rock structure, the distance of the blast effects are reduced as compared to an unconfined blast.

Indirect effects

The regulations for interservice consultation found at 50 CFR 402 define indirect effects as “are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur”. The Corps does not believe that the project will have any indirect effects on manatees or crocodiles in the action area.

Interrelated and Interdependent Effects

The regulations for interservice consultation found at 50 CFR 402 define interrelated actions as “those that are part of a larger action and depend on the larger action for their justification” and interdependent actions as “those that have no independent utility apart from the action under consideration.”

The Corps does not believe that there are any interrelated actions for this proposed project; however, the recommended plan for the Port of Miami contains widening components and deepening components. As a result of the widening components of the project, larger container vessels will call at the Port of Miami. As a result of both the widening and the deepening components of the project, more tonnage will be carried per vessel call, so the total number of vessel calls may be reduced (Dawedit 2002. pers comm.). This will be an indirect benefit to the manatees and crocodiles since there will be fewer ships in the area to potentially affect them. Additionally, the wider channel will provide manatees

and crocodiles more room to maneuver around incoming and outgoing vessels throughout the action area.

The Corps believes that the increase in size within the Port will not have an adverse effect on manatees in the area for three reasons:

- 1) Recent data shows that manatees are not using the Port itself as a primary habitat. Aerial surveys conducted between 1989-2001 show that very few manatees use the area of the Port proper. During the winter, they congregate in the BSCWA area to the south, the Miami River to the northwest, and north of the Julia Tuttle causeway to the north of the Port. Distribution of manatees in the area is also highly seasonal (Figures 2 and 3);
- 2) Efforts being undertaken by the port to comply with the Miami-Dade county MPP's protection provisions.
- 3) As previously demonstrated, fewer manatees are utilizing the general area of the Port in the summer (between April and October), so there are fewer animals in the area that could be affected by the project.

Cumulative effects

The regulations for interservice consultation found at 50 CFR 402 define cumulative effects as “those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consideration.” The Corps is not aware of any future state or private activities, not involving Federal activities that are reasonably certain to occur within the action area.

Take Analysis

Due to the restrictions and special conditions placed in our construction specifications for construction and blasting the Corps does not anticipate any take of the endangered American crocodile or the Florida manatee.

Determination

The Corps has determined that the proposed expansion and deepening of Miami Harbor is likely to affect, but not likely to adversely affect listed species within the action area. The Corps believes that the restrictions placed on construction and blasting previously discussed in this assessment will diminish/eliminate the effect of the project on protected species within the action area.

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Planning Division
Environmental Branch

Ms. Georgia Cranmore
National Marine Fisheries Service
Southeast Regional Office
Protected Species Resources Division
9721 Executive Center Drive North
St. Petersburg, Florida 33702

Dear Ms. Cranmore:

The U.S. Army Corps of Engineers (Corps), Jacksonville District, proposes to conduct a feasibility study to assess Federal interest in navigation improvements throughout the Port of Miami, Miami-Dade County, Florida. An evaluation of benefits, costs, and environmental impacts determines Federal interest.

The recommended plan includes five components: (1) flaring the existing 500-foot wide entrance channel to provide an 800-foot wide entrance channel at Buoy 1, and deepening the entrance channel and widener from an existing depth of 44 feet to a depth of 52 feet; (2) widening the southern intersection of Cut-3 with Lummus Island (Fisherman's) Channel at Buoy 15, and deepening from existing depth of 42 feet to 50 feet; (3) extending the existing Fisher Island turning basin to the north by approximately 300 feet near the west end of Cut-3, and deepening from 43 to 50 feet; (4) relocating the west end of the main channel to about 250 feet to the south (without dredging); and (5) increasing the width of Lummus Island Cut (Fisherman's Channel) about 100 feet to the south of the existing channel, reducing the existing size of the Lummus Island (or Middle) turning basin to a diameter of 1,500 feet, and deepening from the existing 42-foot depth to 50 feet. Additional activities will include mitigation for unavoidable environmental impacts.

Enclosed please find the Corps' Biological Assessment of the effects of the project as currently proposed on listed species in the action area. After preparing this Biological Assessment of the impacts of the proposed project, the Corps has determined that the proposed project may affect, but is not likely to adversely affect the green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), Kemp's ridley turtle (*Lepidochelys kempii*), Hawksbill sea turtle (*Eretmochelys imbricata*),

leatherback turtle (*Dermochelys coriacea*), Johnson's seagrass (*Halophila johnsonii*), blue (*Balenoptera musculus*), humpback, (*Balaenoptera physalus*), sei (*Balaenoptera borealis*), fin (*Balenoptera physalus*) and sperm (*Physeter macrocephalus*) whales and smalltooth sawfish (*Pristis pectinata*), and is not likely to adversely modify designated critical habitat for Johnson's seagrass. We request that you concur with this finding.

If you have any questions, please contact Ms. Terri Jordan at 904-899-5195 or terri.l.jordan@saj02.usace.army.mil.

Sincerely,

James C. Duck
Chief, Planning Division

Enclosure

Jordan/CESAJ-PD-EA/3453/
McAdams/CESAJ-PD-EA
Mason/CESAJ-PD-E
Schwichtenberg/CESAJ-DP-C
Strain/CESAJ-PD-P
Duck/CESAJ-PD

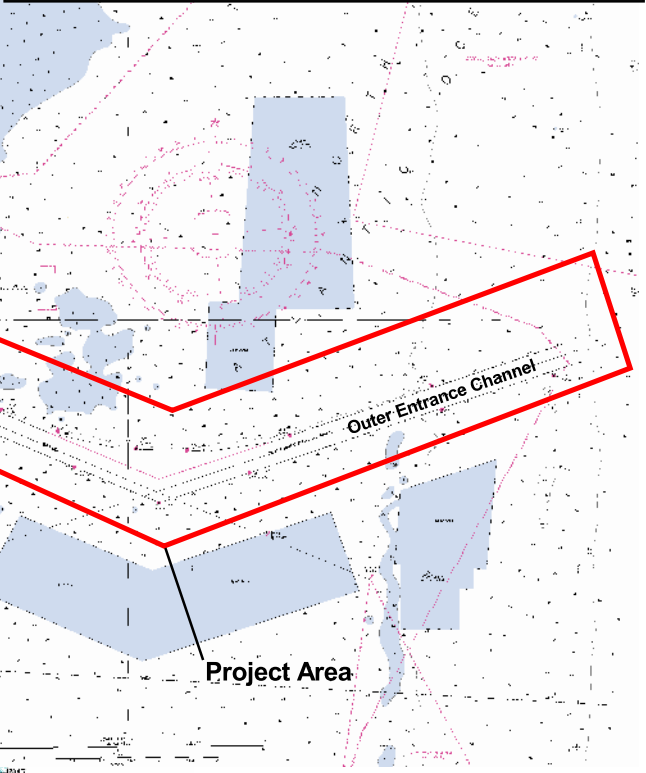
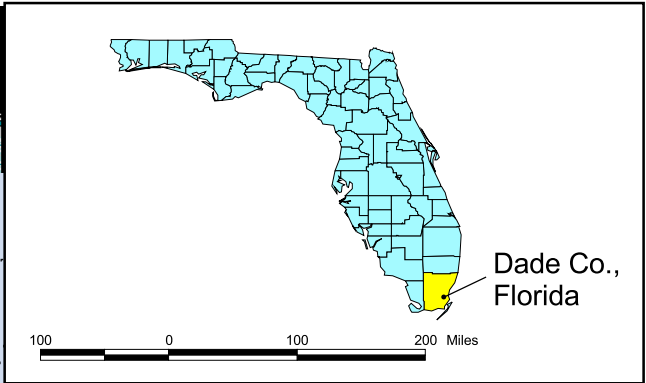
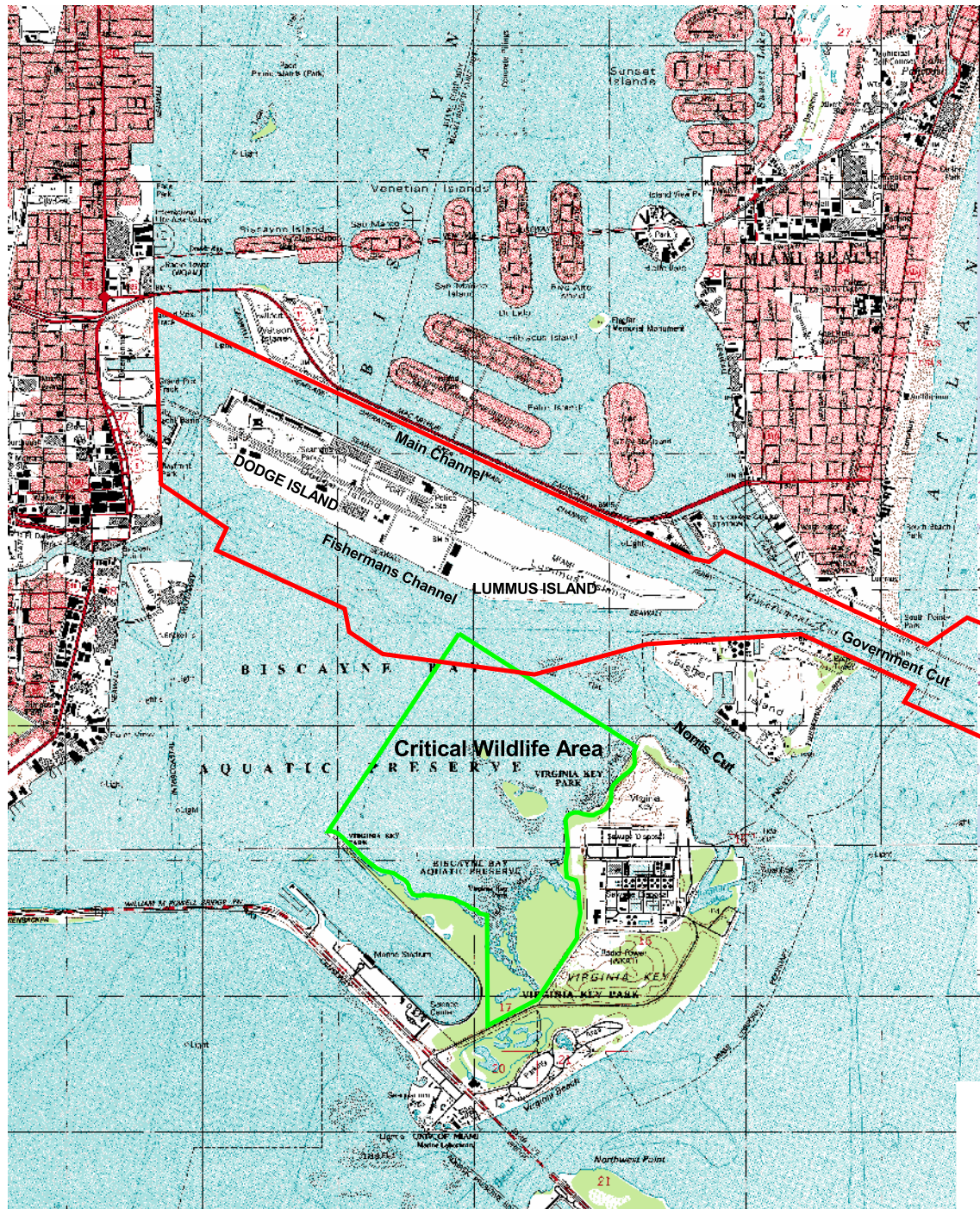
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BIOLOGICAL ASSESSMENT TO THE NATIONAL MARINE FISHERIES SERVICE FOR MIAMI HARBOR NAVIGATION PROJECT GENERAL REEVALUATION REPORT

Description of the Proposed Action – The Port of Miami requested that the U.S. Army Corps of Engineers study the feasibility of widening and deepening most of the major channels and basins within Miami Harbor. A number of alternatives were originally considered, but during efforts to reduce impacts to the environment, many were eliminated from further analysis. Three alternatives were thoroughly analyzed (two action alternatives and the “no action” alternative) in the Environmental Impact Statement. The recommended plan (Alternative 2) includes five components: (1) flaring the existing 500-foot wide entrance channel to provide an 800-foot wide entrance channel at Buoy 1, and deepening the entrance channel and widener from an existing depth of 44 feet to a depth of 52 feet; (2) widening the southern intersection of Cut-3 with Lummus Island (Fisherman’s) Channel at Buoy 15, and deepening from existing depth of 42 feet to 50 feet; (3) extending the existing Fisher Island turning basin to the north by approximately 300 feet near the west end of Cut-3, and deepening from 43 to 50 feet; (4) relocating the west end of the main channel to about 250 feet to the south (without dredging); and (5) increasing the width of Lummus Island Cut (Fisherman's Channel) about 100 feet to the south of the existing channel, reducing the existing size of the Lummus Island (or Middle) turning basin to a diameter of 1,500 feet, and deepening from the existing 42-foot depth to 50 feet. The action alternative not selected included these five components and a sixth, involving the deepening of Dodge Island Cut and creation of another turning basin. Sand, silt, clay, soft rock, rock fragments, and loose rock will be removed via traditional dredging methods. Where hard rock is encountered, the Corps anticipates that contractors will utilize other methods, such as blasting, use of a punch-barge/pile driver, or large cutterhead equipment. Dredged/broken substrates will be deposited at up to four locations. Some rock and coarse materials will be transported by barge and placed at an artificial reef site as mitigation for impacts to hardbottom communities. Other rock/coarse materials will be placed in a previously dredged depression in North Biscayne Bay as part of construction measures to create seagrass habitat. The balance of rock and coarse materials that cannot be utilized will be transported to the Ocean Dredged Material Disposal Site (ODMDS) in accordance with the approved Site Management and Monitoring Plan (SMMP). Viable sand dredged from inshore areas will be relocated and used as a sand cap for the seagrass mitigation site. The balance of sand will be placed on a permitted, upland disposal area on Virginia Key, for possible future use as beach renourishment material by Miami-Dade County.

Action Area

The Port of Miami (Miami-Dade County, Florida) is one of the major port complexes along the east coast of the U.S. The Port utilizes Miami Harbor, which lies in the north side of Biscayne Bay (Figure 1), a shallow, expansive, subtropical lagoon (thirty-eight miles long, and three to nine miles wide) that extends from the City of North Miami south to the northern end of Key Largo. Average depth is six to



- Approximate Extent of Study Area
- Bill Sadowski Critical Wildlife Area

4000 0 4000 8000 12000 Feet



Location Map	
Miami Harbor	
General Reevaluation Report	
Preliminary Draft Environmental Impact Statement	
Scale: 1" = 4,000'	Drawn By: MR
Date: July, 2002	
	J00-499
	Figure 1

ten feet (USACE, 1989). The Bay is bordered on the west by the mainland of peninsular Florida and on the east by both the Atlantic Ocean and a series of barrier islands consisting of sand and carbonate deposits over limestone bedrock (Hoffmeister, 1974). Except for Virginia Key, the islands within and adjacent to the project area (Dodge-Lummus, Fisher, Star, Palm, and Claughton Islands, Watson Park, and the barrier island comprising Miami Beach) are completely developed. A mixture of low, medium and high-density residential areas; commercial enterprises; industrial complexes; office parks; and recreational areas characterizes land surrounding the Port of Miami waters. Specific features found to the north of the port's Main Channel include the MacArthur Causeway (Highway A1A), park/recreation and commercial facilities at Watson Island, the Terminal Island industrial area, and the U.S. Coast Guard Base at Causeway Island. Low-density residential uses are found beyond the MacArthur Causeway on Palm, Hibiscus and Star Islands. Medium and high density residential, park/recreation, commercial, and institutional land uses are found to the east of the port on Fisher Island and the southern portion of the City of Miami Beach. Located approximately one-half mile south of the port, across the waters of Biscayne Bay, is Virginia Key. Land uses found on Virginia Key include park/recreation, environmentally protected areas, and institutional and public facilities including the Miami-Dade County Virginia Key Wastewater Treatment Plant. Miami's Central Business District is found to the west of the port. Habitats within the project impact area include seagrass beds; coral reefs and other hardgrounds; sand-, silt-, and rubble-bottom habitats; and rock/rubble habitats. Other habitats in the vicinity of the project include beaches and mangroves. Adjacent to the harbor is the Biscayne Bay Aquatic Preserve, a *No Entry* zone for protection of manatees, and a Critical Wildlife Area associated with Virginia Key.

Protected Species Included in this Assessment

Of the listed and protected species under NMFS jurisdiction occurring in the action area, the Corps believes that the green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), Kemp's ridley turtle (*Lepidochelys kempii*), Hawksbill sea turtle (*Eretmochelys imbricata*), leatherback turtle (*Dermochelys coriacea*), Johnson's seagrass (*Halophila johnsonii*), blue (*Balaenoptera musculus*), humpback, (*Balaenoptera physalus*), sei (*Balaenoptera borealis*), fin (*Balaenoptera physalus*) and sperm (*Physeter macrocephalus*) whales and smalltooth sawfish (*Pristis pectinata*), may be adversely affected by the implementation of the proposed action. The Corps has relied heavily upon the Surtass LFA Biological Opinion that was completed by NMFS on May 31, 2002 for biological information concerning the biology, life history and status for the large whale species discussed in this assessment. This document was accessed from the NMFS website at:

http://www.nmfs.noaa.gov/prot_res/readingrm/ESAsec7/7pr_surtass-2020529.pdf.

The Corps has reviewed the biological, status, threats and distribution information presented in this assessment and believes that the following species will be in or near the action area and thus may be affected by the proposed project: the five sea turtle species; humpback and sperm whales and smalltooth sawfish.

Six species of endangered marine mammals may be found seasonally in the waters offshore southeastern

Florida. The Corps believes that only the sperm and humpback whales may be adversely affected by activities associated with the proposed action. These effects would be a result of acoustic harassment.

The blue, fin, northern right and sei whales are not discussed because they are unlikely to be within the vicinity of the project. Additional information on blue, fin and sei whales can be found in Waring *et al.* (1999). Due to the rarity of sightings of these four whale species near the project area, the Corps believes that any effects to them by the project are discountable. Discountable effects under Section 7 of the ESA are those “extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.”

The endangered Florida manatee (*Trichechus manatus*) and the American crocodile (*Crocodylus acutus*) also occur with the action area and the Corps has initiated consultation with the U.S. Fish and Wildlife Service concerning the effects of the proposed action on these species.

Species and Suitable Habitat Descriptions

Green Turtle (*Chelonia mydas*)

Distribution. Green turtles are distributed circumglobally. In the western Atlantic they range from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean, but are considered rare north of Cape Hatteras (Wynne and Schwartz, 1999). Several major nesting assemblages have been identified and studied in the western Atlantic (Peters 1954; Carr and Ogren, 1960; Carr *et al.*, 1978). Most green turtle nesting in the continental United States occurs on the Atlantic Coast of Florida (Ehrhart 1979). Green turtles are the largest of the hard-shelled sea turtles. Adult male green turtles are smaller than adult females whose lengths range from 92 to 110 cm (36 to 43 in.) and weights range from 119 to 182 kg (200 to 300 lbs). Their heads are small compared to other sea turtles and the biting edge of their lower jaws is serrated.

Green turtles have a more tropical distribution than loggerhead turtles; they are generally found in waters between the northern and southern 20°C isotherms (Hirth 1971). Green turtles, like most other sea turtles, are distributed more widely in the summer when warmer water temperatures allow them to migrate north along the Atlantic coast of North America. In the summer, green turtles are found around the U.S. Virgin Islands, Puerto Rico, and continental North America from Texas to Massachusetts. Immature greens can be distributed in estuarine and coastal waters from Long Island Sound, Chesapeake Bay, and the North Carolina sounds south throughout the tropics (Musick and Limpus, 1997). In the United States, green turtles nest primarily along the Atlantic Coast of Florida, the U.S. Virgin Islands, and Puerto Rico. In the winter, as water temperatures decline, green turtles that are found north of Florida begin to migrate south into subtropical and tropical water.

Status and Population Trends. The green turtle was protected under the ESA in 1978; breeding populations off the coast of Florida and the Pacific coast of Mexico are listed as endangered, all other populations are listed as threatened. Recent population estimates for the western Atlantic area are not

available. However, there is evidence that green turtle nesting has been on the increase during the past decade. Recently, green turtle nesting occurred on Bald Head Island, North Carolina just east of the mouth of the Cape Fear River, on Onslow Island, and on Cape Hatteras National Seashore. Increased nesting has also been observed along the Atlantic Coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997). Certain Florida nesting beaches where most green turtle nesting activity occurs have been designated index beaches. Index beaches were established to standardize data collection methods and effort on key nesting beaches. The pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the six years of regular monitoring since establishment of the index beaches in 1989. A nesting summary for the county in which the proposed project resides is found in Table 1. The majority of sea turtle nesting activity occurred during the summer months of June, July and August, with nesting activity occurring as early as March and as late as September (Miami-Dade County, 2000). Ten green turtle carcasses have been found in the vicinity of the action area (Wendy Teas, pers com, 2002, NMFS - SEFSC Miami Laboratory).

Table 1: Summary of Green Turtle (*Chelonia mydas*) Nesting in Miami-Dade County, 1988-2001

Year	Beach Length (km)	Number of Nests	Number of Non-Nesting Emergences	Date of First Nest	Date of Last Nest
1988	29.9	6	2	06/13/88	07/08/88
1989	29.9	2	6	07/01/89	07/07/89
1990	31.5	3	2	05/16/90	07/01/90
1991	30.7	2	2	07/17/91	07/26/91
1992	38.6	4	5	06/27/92	08/03/92
1993	38.9	1	0	06/20/93	06/20/93
1994	34.7	1	1	06/02/94	06/02/94
1995	37.4	2	0	05/21/95	06/27/95
1996	37.6	12	13	06/17/96	08/19/96
1997	38.1	0	2	-	-
1998	38.1	4	10	05/31/98	07/28/98
1999	37.8	64	78	04/23/99	08/18/99
2000	37.8	5	7	06/20/00	07/28/00
2001	37.8	0	0	-	-

Source: Florida Marine Research Institute. 2002a

Natural History. While nesting activity is obviously important in determining population distributions, the remaining portion of the green turtle's life is spent on the foraging grounds. Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida, the northwestern coast of the Yucatan Peninsula, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean Coast of Panama, and scattered areas along Colombia and Brazil (Hirth 1971). Juvenile green sea turtles occupy pelagic habitats after leaving the nesting beach. Pelagic juveniles are assumed to be omnivorous, but with a strong tendency toward carnivory during early life stages. At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas, shifting to a chiefly herbivorous diet (Bjorndal 1997). Post-pelagic green turtles feed primarily on sea grasses and benthic algae but also consume jellyfish, salps, and sponges. In the western Atlantic region, the summer developmental habitat encompasses estuarine and coastal waters as far north as Long Island Sound, Chesapeake Bay, and North Carolina sounds, and south throughout the tropics

(Musick and Limpus, 1997). Like loggerheads and Kemp's ridleys, green sea turtles that use northern waters during the summer must return to southern waters in autumn, or face the risk of cold stunning.

Threats. The greatest threat to this species is the loss of its nesting habitat. Throughout the tropical and subtropical distribution of this species, beaches are eroded, armored, renourished, or converted for residential or commercial purposes. Green turtles are also threatened by fibropapilloma disease; incidental takes in commercial or recreational fishing gear; and poaching (although poaching is infrequent in the United States). Green turtles are harvested in some nations for food, leather, and jewelry. Green turtles are also threatened by natural causes including hurricanes; predation by fire ants, raccoons, and opossums; and poaching of eggs and nesting females.

Anthropogenic impacts to the green turtle population are similar to those for other sea turtle species. Sea sampling coverage in the pelagic driftnet, pelagic longline, scallop dredge, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles. In addition, the NMFS/Northeast Fisheries Science Center (NEFSC) is conducting a review of bycatch levels and patterns in all fisheries in the western Atlantic for which observer data is available. Bycatch estimates will be made for all fisheries for which sample sizes are sufficiently large to permit reasonable statistical analysis. This will be compiled into an assessment report. Until that analysis is completed, the only information on the magnitude of takes available for fisheries in the action area are unextrapolated numbers of observed takes from the sea sampling data. Preliminary sea sampling data summary (1994-1998) shows the following total take of green turtles: one (anchored gillnet), two (pelagic driftnet), and two (pelagic longline). Stranding reports indicate that between 200-300 green turtles strand annually from a variety of causes (Sea Turtle Stranding and Salvage Network, unpublished data). As with the other species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of other mortality.

Critical Habitat. In 1998, NMFS designated the waters surrounding the islands of Culebra, Puerto Rico as critical habitat for the green turtle. This area supports major seagrass beds and reefs that provide forage and shelter habitat. The action area does not comprise critical habitat for green turtles.

Loggerhead Turtle (*Caretta caretta*)

Distribution. Loggerhead turtles occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans and are the most abundant species of sea turtle occurring in U.S. waters. Loggerheads concentrate their nesting in the north and south temperate zones and subtropics, but generally avoid nesting in tropical areas of Central America, northern South America, and the Old World (NRC 1990). The largest known nesting aggregation of loggerhead turtles occurs on Masirah and Kuria Muria Islands in Oman (Ross and Barwani, 1982). In the western Atlantic, most loggerhead turtles nest from North Carolina to Florida and along the gulf coast of Florida. The best scientific and commercial data available on the genetics of loggerhead turtles suggests there are four major subpopulations of loggerheads in the northwest Atlantic: (1) a northern nesting subpopulation that occurs

from North Carolina to northeast Florida, about 29° N (approximately 7,500 nests in 1998); (2) a south Florida nesting subpopulation, occurring from 29° N on the east coast to Sarasota on the west coast (approximately 83,400 nests in 1998); (3) a Florida panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida (approximately 1,200 nests in 1998); and (4) a Yucatán nesting subpopulation, occurring on the eastern Yucatán Peninsula, Mexico (Márquez 1990) (approximately 1,000 nests in 1998, according to TEWG, 2000). This biological opinion will focus on the northwest Atlantic subpopulations of loggerhead turtles, which occur in the action area. A nesting summary for the county in which the action is proposed is included in Table 2. The majority of sea turtle nesting activity occurred during the summer months of June, July and August, with nesting activity occurring as early as March and as late as September (Miami-Dade County, 2000). Seven loggerhead turtle carcasses have been found in the vicinity of the action area (Wendy Teas, pers com, 2002, NMFS - SEFSC Miami Laboratory).

Table 2: Summary of Loggerhead (*Caretta caretta*) Nesting in Miami-Dade County, 1988-2001

Year	Beach Length (km)	Number of Nests	Number of Non-Nesting Emergences	Date of First Nest	Date of Last Nest
1988	29.9	219	196	05/02/88	08/27/88
1989	29.9	325	407	04/17/89	08/12/89
1990	31.5	390	486	04/07/90	08/22/90
1991	30.7	439	510	04/25/91	08/28/91
1992	38.6	367	416	04/23/92	09/15/92
1993	38.9	392	401	04/28/93	10/03/93
1994	34.7	445	454	04/22/94	08/30/94
1995	37.4	470	595	04/29/95	08/27/95
1996	37.6	448	517	04/26/96	08/20/96
1997	38.1	415	599	04/23/97	08/14/97
1998	38.1	545	937	04/18/98	08/26/98
1999	37.8	516	565	04/10/99	08/18/99
2000	37.8	516	775	04/12/00	09/20/00
2001	37.8	496	564	04/19/01	08/21/01

source: Florida Marine Research Institute. 2002b

Although NMFS and FWS have not completed the administrative processes necessary to formally recognize populations or subpopulations of loggerhead turtles, these sea turtles are generally grouped by nesting locations. Based on the most recent reviews of the best scientific and commercial data on the population genetics of loggerhead sea turtles and analyses of their population trends (TEWG, 1998; TEWG 2000), NMFS and FWS treat these loggerhead turtle nesting aggregations as distinct subpopulations whose survival and recovery is critical to the survival and recovery of the species. Further, any action that appreciably reduced the likelihood that one or more of these nesting aggregations would survive and recover would appreciably reduce the species' likelihood of survival and recovery in the wild. Consequently, this biological opinion will focus on the four nesting aggregations of loggerhead turtles identified in the preceding paragraph (which occur in the action area) and treat them as subpopulations for the purposes of this analysis. Natal homing to the nesting beach provides the genetic barrier between these subpopulations, preventing recolonization from turtles from

other nesting beaches. The importance of maintaining these subpopulations in the wild is shown by the many examples of extirpated nesting assemblages in the world. In addition, recent fine-scale analysis of mtDNA work from Florida rookeries indicate that population separations begin to appear between nesting beaches separated by more than 50-100 km of coastline that does not host nesting (Francisco *et al.* 2000) and tagging studies are consistent with this result (Richardson 1982, Ehrhart 1979, LeBuff 1990, CMTTP: in NMFS SEFSC 2001). Nest site relocations greater than 100 km occur, but generally are rare (Ehrhart 1979; LeBuff 1974, 1990; CMTTP; Bjorndal *et al.* 1983: in NMFS SEFSC 2001).

The loggerhead turtles in the action area are likely to represent differing proportions of the four western Atlantic subpopulations. Although the northern nesting subpopulation produces about 9% of the loggerhead nests, they comprise more of the loggerhead sea turtles found in foraging areas from the northeastern U.S. to Georgia: between 25 and 59 percent of the loggerhead turtles in this area are from the northern subpopulation (NMFS SEFSC 2001; Bass *et al.*, 1998; Norrgard, 1995; Rankin-Baransky, 1997; Sears 1994, Sears *et al.*, 1995). In the Carolinas, the northern subpopulation is estimated to make up from 25% to 28% of the loggerheads (NMFS SEFSC 2001; Bass *et al.* 1998, 1999). About ten percent of the loggerhead turtles in foraging areas off the Atlantic coast of central Florida are from the northern subpopulation (Witzell *et al.*, in prep). In the Gulf of Mexico, most of the loggerhead turtles in foraging areas will be from the South Florida subpopulation, although the northern subpopulation may represent about 10% of the loggerhead sea turtles in the Gulf (Bass pers. comm). In the Mediterranean Sea, about 45 - 47 percent of the pelagic loggerheads are from the South Florida subpopulation and about two percent are from the northern subpopulation, while only about 51% originated from Mediterranean nesting beaches (Laurent *et al.*, 1998). In the vicinity of the Azores and Madeira Archipelagoes, about 19% of the pelagic loggerheads are from the northern subpopulation, about 71% are from the South Florida subpopulation, and about 11% are from the Yucatán subpopulation (Bolten *et al.*, 1998).

Natural History. Loggerhead turtles originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for as long as 7-12 years. Turtles in this life history stage are called “pelagic immatures” and are best known from the eastern Atlantic near the Azores and Madeira and have been reported from the Mediterranean as well as the eastern Caribbean (Bjorndal *et al.*, in press). Stranding records indicate that when pelagic immature loggerheads reach 40-60 cm SCL they recruit to coastal inshore and nearshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico.

Benthic immatures have been found from Cape Cod, Massachusetts, to southern Texas, and occasionally strand on beaches in northeastern Mexico (R. Márquez-M., pers. comm.). Large benthic immature loggerheads (70-91 cm) represent a larger proportion of the strandings and in-water captures (Schroeder *et al.*, 1998) along the south and western coasts of Florida as compared with the rest of the coast, but it is not known whether the larger animals actually are more abundant in these areas or just more abundant within the area relative to the smaller turtles. Benthic immature loggerheads foraging in

northeastern U.S. waters are known to migrate southward in the fall as water temperatures cool (Epperly *et al.*, 1995; Keinath, 1993; Morreale and Standora, 1999; Shoop and Kenney, 1992), and migrate northward in spring. Given an estimated age at maturity of 21-35 years (Frazer and Ehrhart, 1985; Frazer and Limpus, 1998), the benthic immature stage must be at least 10-25 years long. NMFS SEFSC 2001 analyses conclude that juvenile stages have the highest elasticity and maintaining or decreasing current sources of mortality in those stages will have the greatest impact on maintaining or increasing population growth rates.

Like other sea turtles, the movements of loggerheads are influenced by water temperature. Since they are limited by water temperatures, sea turtles do not usually appear on the summer foraging grounds until June, but are found in Virginia as early as April. The large majority leaves the Gulf of Maine by mid-September but may remain in these areas until as late as November and December. Loggerhead sea turtles are primarily benthic feeders, opportunistically foraging on crustaceans and mollusks (Wynne and Schwartz, 1999). Under certain conditions they may also scavenge fish, particularly if they are easy to catch (e.g., caught in nets) (NMFS and USFWS, 1991).

Adult female loggerheads in the western Atlantic come ashore to nest primarily from North Carolina southward to Florida. Additional nesting assemblages occur in the Florida Panhandle and on the Yucatán Peninsula. Non-nesting, adult female loggerheads are reported throughout the U.S. and Caribbean Sea; however, little is known about the distribution of adult males who are seasonally abundant near nesting beaches during the nesting season. Aerial surveys suggest that loggerheads (benthic immatures and adults) in U.S. waters are distributed in the following proportions: 54% in the southeast U.S. Atlantic, 29% in the northeast U.S. Atlantic, 12% in the eastern Gulf of Mexico, and 5% in the western Gulf of Mexico (TEWG 1998).

Threats. Loggerhead sea turtles face a number of human-related threats in the marine environment, including oil and gas exploration, development, and transportation; marine pollution; trawl, purse seine, hook and line, gill net, pound net, longline, and trap fisheries (see below); underwater explosions; dredging, offshore artificial lighting; power plant entrapment; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; and poaching.

Although loggerhead turtles are most vulnerable to pelagic longlines during their pelagic, immature life history stage, there is some evidence that benthic immatures may also be captured, injured, or killed by pelagic fishery operations. Recent studies have suggested that not all loggerhead turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic immatures, followed by permanent settlement into benthic environments. Some may not totally circumnavigate the North Atlantic. In addition, some of these turtles may either remain in the pelagic habitat in the North Atlantic longer than hypothesized or they may move back and forth between pelagic and coastal habitats (Witzell in prep.). Any loggerhead turtles that follow this developmental model would be adversely affected by shark gill nets and shark bottom longlines set in coastal waters, in addition to pelagic longlines.

On their nesting beaches in the U.S., loggerhead turtles are threatened with beach erosion, armoring, and nourishment; artificial lighting; beach cleaning; increased human presence; recreational beach equipment; exotic dune and beach vegetation; predation by fire ants, raccoons, armadillos, opossums; and poaching. Elimination/control of these threats are especially important because, from a global perspective, the southeastern U.S. nesting aggregation is critical to the survival of this species: it is second in size only to the nesting aggregations in the Arabian Sea off Oman and represents about 35 and 40 percent of the nests of this species. The status of the Oman nesting beaches has not been evaluated recently, but they are located in a part of the world that is vulnerable to extremely disruptive events (e.g. political upheavals, wars, and catastrophic oil spills), the resulting risk facing this nesting aggregation and these nesting beaches is cause for considerable concern (Meylan *et al.*, 1995).

Loggerhead turtles also face numerous threats from weather and coastal processes. For example, there is a significant overlap between hurricane seasons in the Caribbean Sea and northwest Atlantic Ocean (June to November) and loggerhead turtle nesting season (March to November); hurricanes can have potentially disastrous effects on the survival of eggs in sea turtle nests. In 1992, Hurricane Andrew affected turtle nests over a 90-mile length of coastal Florida; all of the eggs were destroyed by storm surges on beaches that were closest to the eye of this hurricane (Milton *et al.*, 1992). On Fisher Island near Miami, Florida, 69% of the eggs did not hatch after Hurricane Andrew, probably because they were drowned by the storm surge. Nests from the northern subpopulation were destroyed by hurricanes, which made landfall in North Carolina in the mid to late 1990's. Sand accretion and rainfall that result from these storms can appreciably reduce hatchling success. These natural phenomena probably have significant, adverse effects on the size of specific year classes; particularly given the increasing frequency and intensity of hurricanes in the Caribbean Sea and northwest Atlantic Ocean.

Status and Population Trends. The loggerhead turtle was listed as threatened under the ESA on July 28, 1978. The most recent work updating what is known regarding status and trends of loggerhead sea turtles is contained in NMFS SEFSC 2001. The recovery plan for this species (NMFS and USFWS 1991) state that southeastern U.S. loggerheads can be considered for delisting if, over a period of 25 years, adult female populations in Florida are increasing and there is a return to pre-listing annual nest numbers totaling 12,800 for North Carolina, South Carolina, and Georgia combined. This equates to approximately 3,100 nesting females per year at 4.1 nests per female per season. NMFS SEFSC 2001 concludes, "...nesting trends indicate that the numbers of females associated with the South Florida subpopulation are increasing. Likewise, nesting trend analyses indicate potentially increasing nest numbers in the northern subpopulation" (TEWG 2000). However, NMFS SEFSC 2001 also cautions that given the uncertainties in survival rates (of the different life stages, particularly the pelagic immature stage), and the stochastic nature of populations, population trajectories should not be used now to quantitatively assess when the northern subpopulation may achieve 3,100 nesting females.

Several published reports have presented the problems facing long-lived species that delay sexual maturity in a world replete with threats from a modern, human population (Crouse *et al.*, 1987, Crowder *et al.*, 1994, Crouse 1999). In general, these reports concluded that animals that delay sexual

maturity and reproduction must have high, annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes. This general tenet of population ecology originated in studies of sea turtles (Crouse *et al.*, 1987, Crowder *et al.*, 1994, Crouse 1999). Heppell *et al.* (in prep.) specifically showed that the growth of the loggerhead sea turtle population was particularly sensitive to changes in the annual survival of both juvenile and adult sea turtles and that the adverse effects of the pelagic longline fishery on loggerheads from the pelagic immature phase appeared critical to the survival and recovery of the species. Crouse (1999) concluded that relatively small changes in annual survival rates of both juvenile and adult loggerhead sea turtles would adversely affect large segments of the total loggerhead sea turtle population.

The four major subpopulations of loggerhead sea turtles in the northwest Atlantic, northern, south Florida, Florida panhandle, and Yucatán are all subject to fluctuations in the number of young produced annually because of natural phenomena like hurricanes as well as human-related activities. Although sea turtle nesting beaches are protected along large expanses of the northwest Atlantic coast (in areas like Merrit Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection and probably cause fluctuations in sea turtle nesting success. Sea turtles nesting in the southern and central counties of Florida can be affected by beach armoring, beach renourishment, beach cleaning, artificial lighting, predation, and poaching (NMFS & FWS 1991).

As discussed previously, the survival of juvenile loggerhead sea turtles is threatened by a completely different set of threats from human activity once they migrate to the ocean. Pelagic immature loggerhead sea turtles from these four subpopulations circumnavigate the North Atlantic over several years (Carr 1987, Bjorndal 1994). During that period, they are exposed to a series of long-line fisheries that include an Azorean long-line fleet, a Spanish long-line fleet, and various fleets in the Mediterranean Sea (Aguilar *et al.*, 1995, Bolten *et al.*, 1994, Crouse 1999). Based on their proportional distribution, the capture of immature loggerhead sea turtles in long-line fleets in the Azores and Madeira Archipelagoes and the Mediterranean Sea will have a significant, adverse effect on the annual survival rates of juvenile loggerhead sea turtles from the western Atlantic subpopulations, with a disproportionately large effect on the northern subpopulation that may be significant at the population level.

In waters off coastal U.S., a suite of fisheries in Federal and State waters threatens the survival of juvenile loggerhead sea turtles. Loggerhead turtles are captured, injured, or killed in shrimp fisheries off the Atlantic coast; along the southeastern Atlantic coast, loggerhead turtle populations are declining where shrimp fishing is intense off the nesting beaches (NRC 1990). Conversely these nesting populations do not appear to be declining where nearshore shrimping effort is low or absent. The management of shrimp harvest in the Gulf of Mexico demonstrates the correlation between shrimp trawling and impacts to sea turtles. Waters out to 200nm are closed to shrimp fishing off of Texas each year for approximately a three-month period (mid- May through mid-July) to allow shrimp to migrate out of estuarine waters; sea turtle strandings decline dramatically during this period (NMFS, STSSN unpublished data). Loggerhead sea turtles are captured in fixed pound-net gear in the Long Island

Sound, in pound-net gear and trawls in summer flounder and other finfish fisheries in the mid-Atlantic and Chesapeake Bay, in gill net fisheries in the mid-Atlantic and elsewhere, in fisheries for monkfish and for spiny dogfish, and in northeast sink gillnet fisheries (see further discussion in the *Environmental Baseline* of this Opinion). Witzell (1999) compiled data on capture rates of loggerhead and leatherback turtles in U.S. longline fisheries in the Caribbean and northwest Atlantic; the cumulative takes of these fisheries approach those of the U.S. shrimp fishing fleet (Crouse 1999, NRC 1990).

Based on the data available, it is not possible to estimate the size of the loggerhead population in the U.S. or its territorial waters. There is, however, general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage. Nesting data collected on index nesting beaches in the U.S. from 1989-1998 represent the best dataset available to index the population size of loggerhead turtles. However, an important caveat for population trends analysis based on nesting beach data is that this may reflect trends in adult nesting females, but it may not reflect overall population growth rates. Given this, between 1989 and 1998, the total number of nests laid along the U.S. Atlantic and Gulf coasts ranged from 53,016-89,034 annually, representing, on average, an adult female population of 44,780 [(nests/4.1) * 2.5]. On average, 90.7% of the nests were from the South Florida subpopulation, 8.5% were from the northern subpopulation, and 0.8% were from the Florida Panhandle subpopulation. There is limited nesting throughout the Gulf of Mexico west of Florida, but it is not known to what subpopulation they belong. Based on the above, there are only an estimated 3,800 nesting females in the northern loggerhead subpopulation. The status of this population, based on number of loggerhead nests, has been classified as stable or declining (TEWG 2000). Another consideration adding to the vulnerability of the northern subpopulation is that NMFS scientists estimate, using genetics data from Texas, South Carolina, and North Carolina in combination with juvenile sex ratios from those states, that the northern subpopulation produces 65% males, while the Florida subpopulation is estimated to produce 80% females (NMFS SEFSC 2001, Part I).

Critical Habitat. No critical habitat has been designated for loggerhead turtles.

Hawksbill Turtle (*Eretmochelys imbricata*)

Distribution. Hawksbill turtles occur in tropical and subtropical waters of the Atlantic, Pacific, and Indian Oceans. Recognized subspecies occupy the Atlantic Ocean (ssp. *imbricata*) and the Pacific Ocean (ssp. *squamata*). Richardson *et al.* (1989) estimated that the Caribbean and Atlantic portions of the U.S. support a minimum of 650 hawksbill turtle nests each year. In the United States, hawksbill turtles have been recorded in all states along the Gulf of Mexico and along the Atlantic coast from Florida to Massachusetts. United States populations nest primarily in the U.S. Virgin Islands and Puerto Rico, but occasionally on the Atlantic coast of Florida. Two hawksbill turtle carcasses have been found in the vicinity of the action area (Wendy Teas, pers com, 2002, NMFS - SEFSC Miami Laboratory).

Natural History. Hawksbill turtles use different habitats for different stages in their life cycles. Post-hatchling hawksbill turtles remain in pelagic environments to take shelter in weedlines that accumulate at

convergence points. Juvenile hawksbill turtles (those with carapace lengths of 20-25 cm) re-enter coastal waters where they become residents of coral reefs, which provide sponges for food and ledges, and caves for shelter. Hawksbill turtles are also found around rocky outcrops, high-energy shoals, and mangrove-fringed bays and estuaries (particularly in areas where coral reefs do not occur). Hawksbill turtles remain in coastal waters when they become subadults and adults.

Status and Threats. The hawksbill turtle was listed as an endangered species on June 2, 1970 (35 FR 8491). Populations are threatened by significant modifications of its coastal habitat throughout its range. The National Research Council (1990), and NMFS/FWS (1993) have published general overviews of the effects of habitat alteration on hawksbill turtles. In the U.S. Virgin Islands, problems such as egg poaching, domestic animals, beach driving, litter, and recreational use of beaches have presented problems for nesting hawksbill turtles. In addition, beachfront lights appear to pose a serious problem for hatchling hawksbill (and other) turtles in the U.S. Virgin Islands. At sea, activities that damage coral reefs and other habitats that are important to the hawksbill turtle threaten the continued existence of this species. Hawksbill turtles are also threatened by stochastic events (e.g., hurricanes); predation by fire ants, raccoons and opossums; and by poaching of eggs and nesting females by humans.

Critical Habitat. In 1998, NMFS designated the waters surrounding Mona and Monito Islands, Puerto Rico as critical habitat for the hawksbill turtle. The action area does not comprise designated critical habitat for the species.

Kemp's Ridley Turtle (*Lepidochelys kempii*)

Status and Population Trends. Of the seven extant species of sea turtles of the world, the Kemp's ridley has declined to the lowest population level. The Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempi*) (USFWS and NMFS 1992) contains a description of the natural history, taxonomy, and distribution of the Kemp's ridley turtle. Kemp's ridleys nest in daytime aggregations known as *arribadas*. The primary arribada in the Gulf of Mexico is at Rancho Nuevo, a stretch of beach in Mexico. Most of the population of adult females nest in this single locality (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the early 1970's, the world population estimate of mature female Kemp's ridleys had been reduced to 2,500-5,000 individuals. The population declined further through the mid-1980s. Recent observations of increased nesting suggest that the decline in the ridley population has stopped and there is cautious optimism that the population is now increasing.

After unprecedented numbers of Kemp's ridley carcasses were reported from Texas and Louisiana beaches during periods of high levels of shrimping effort, NMFS established a team of population biologists, sea turtle scientists, and managers, known as the Turtle Expert Working Group (TEWG) to conduct a status assessment of sea turtle populations. Analyses conducted by the group have indicated that the Kemp's ridley population is in the early stages of recovery; however, strandings in some years have increased at rates higher than the rate of increase in the Kemp's population (TEWG 1998).

The TEWG (1998) developed a population model to evaluate trends in the Kemp's ridley population through the application of empirical data and life history parameter estimates chosen by the TEWG. Model results identified three trends in benthic immature Kemp's ridleys. Benthic immatures are those turtles that are not yet reproductively mature but have recruited to feed in the nearshore benthic environment where they are available to nearshore mortality sources that often result in strandings. Benthic immature ridleys are estimated to be 2-9 years of age and 20-60 cm in length. Increased production of hatchlings from the nesting beach beginning in 1966 resulted in an increase in benthic ridleys that leveled off in the late 1970s. A second period of increase followed by leveling occurred between 1978 and 1989 as hatchling production was further enhanced by the cooperative program between the U.S. Fish and Wildlife Service (FWS) and Mexico's Instituto Nacional de Pesca to increase the nest protection and relocation program in 1978. A third period of steady increase, which has not leveled off to date, has occurred since 1990 and appears to be due to the greatly increased hatchling production and an apparent increase in survival rates of immature turtles beginning in 1990 due, in part, to the introduction of turtle excluder devices (TEDs). Adult ridley numbers have now grown from a low of approximately 1,050 adults producing 702 nests in 1985, to greater than 3,000 adults producing 1,940 nests in 1995 and about 3,400 nests in 1999.

The TEWG (1998) was unable to estimate the total population size and current mortality rates for the Kemp's ridley population. However, the TEWG listed a number of preliminary conclusions. The TEWG indicated that the Kemp's ridley population appears to be in the early stage of exponential expansion. Over the period 1987 to 1995, the rate of increase in the annual number of nests accelerated in a trend that would continue with enhanced hatchling production and the use of TEDs. Nesting data indicated that the number of adults declined from a population that produced 6,000 nests in 1966 to a population that produced 924 nests in 1978 and a low of 702 nests in 1985. This trajectory of adult abundance tracks with trends in nest abundance from an estimate of 9,600 in 1966 to 1,050 in 1985. The TEWG estimated that in 1995 there were 3,000 adult ridleys. The increased recruitment of new adults is illustrated in the proportion of neophyte, or first time nesters, which has increased from 6% to 28% from 1981 to 1989 and from 23% to 41% from 1990 to 1994. The population model in the TEWG projected that Kemp's ridleys could reach the intermediate recovery goal identified in the Recovery Plan of 10,000 nesters by the year 2020 if the assumptions of age to sexual maturity and age specific survivorship rates plugged into their model are correct. It determined that the data reviewed suggested that adult Kemp's ridley turtles were restricted somewhat to the Gulf of Mexico in shallow near shore waters, and benthic immature turtles of 20-60 cm straight line carapace length are found in nearshore coastal waters including estuaries of the Gulf of Mexico and the Atlantic.

The TEWG (1998) identified an average Kemp's ridley population growth rate of 13% per year between 1991 and 1995. Total nest numbers have continued to increase. However, the 1996 and 1997 nest numbers reflected a slower rate of growth, while the increase in the 1998 nesting level has been much higher and decreased in 1999. The population growth rate does not appear as steady as originally forecasted by the TEWG, but annual fluctuations, due in part to irregular inter-nesting periods,

are normal for other sea turtle populations. Also, as populations increase and expand, nesting activity would be expected to be more variable.

The area surveyed for ridley nests in Mexico was expanded in 1990 due to destruction of the primary nesting beach by Hurricane Gilbert. The TEWG (1998) assumed that the increased nesting observed particularly since 1990 was a true increase, rather than the result of expanded beach coverage. Because systematic surveys of the adjacent beaches were not conducted prior to 1990, there is no way to determine what proportion of the nesting increase documented since that time is due to the increased survey effort rather than an expanding ridley nesting range. As noted by TEWG, trends in Kemp's ridley nesting even on the Rancho Nuevo beaches alone suggest that recovery of this population has begun but continued caution is necessary to ensure recovery and to meet the goals identified in the Kemp's Ridley Recovery Plan.

Natural History. Juvenile Kemp's ridleys use northeastern and mid-Atlantic coastal waters of the U.S. Atlantic coastline as primary developmental habitat during summer months, with shallow coastal embayments serving as important foraging grounds. Post-pelagic ridleys feed primarily on crabs, consuming a variety of species, including *Callinectes* sp., *Ovalipes* sp., *Libinia* sp., and *Cancer* sp. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal, 1997). Juvenile ridleys migrate south as water temperatures cool in fall, and are predominantly found in shallow coastal embayments along the Gulf Coast during fall and winter months.

Ridleys found in mid-Atlantic waters are primarily post-pelagic juveniles averaging 40 centimeters in carapace length, and weighing less than 20 kilograms (Klinger and Musick 1995). Next to loggerheads, they are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June, and migrating to more southerly waters from September to November (Keinath *et al.*, 1987; Musick and Limpus, 1997). In the Chesapeake Bay, ridleys frequently forage in shallow embayments, particularly in areas supporting submerged aquatic vegetation (Lutcavage and Musick, 1985; Bellmund *et al.*, 1987; Keinath *et al.*, 1987; Musick and Limpus, 1997). The juvenile population in Chesapeake Bay is estimated to be 211 to 1,083 turtles (Musick and Limpus, 1997).

Research being conducted by Texas A&M University has resulted in the intentional live-capture of hundreds of Kemp's ridleys at Sabine Pass and the entrance to Galveston Bay. Between 1989 and 1993, Galveston NMFS Laboratory staff tracked 50 of these turtles using satellite and radio telemetry. The tracking study was designed to characterize sea turtle habitat and to identify small and large-scale migration patterns. Preliminary analysis of the data collected during these studies suggests that subadult Kemp's ridleys stay in shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida coast (Renaud, NMFS Galveston Laboratory, pers. comm.).

Threats. Observations in the northeast otter trawl fishery, pelagic longline fishery, and southeast shrimp and summer flounder bottom trawl fisheries have recorded takes of Kemp's ridley turtles. As with loggerheads, a large number of Kemp's ridleys are taken in the southeast shrimp fishery each year.

Kemp's ridleys were also affected by the apparent large-mesh gillnet interaction that occurred in spring off of North Carolina. A total of five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 277 loggerhead carcasses were found. This is expected to be a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction since it is unlikely that all carcasses washed ashore. Stranding events illustrate the vulnerability of Kemp's ridley and loggerhead turtles to the impacts of human activities in nearshore Gulf of Mexico waters as well (TEWG 1998). While many of the stranded turtles observed in recent years in Texas and Louisiana have been incidentally taken in the shrimp fishery, other sources of mortality, such as those observed in the northeastern and southeastern Atlantic zones, exist in these waters.

Critical Habitat. No critical habitat has been designated for the Kemp's ridley turtle.

Leatherback Turtle (*Dermochelys coriacea*)

Species Description and Distribution

The leatherback is the largest living turtle. Leatherback sea turtles are widely distributed throughout the oceans of the world, and are found throughout waters of the Atlantic, Pacific, Caribbean, and the Gulf of Mexico (Ernst and Barbour 1972).

Leatherback turtles undertake the longest migrations of any other sea turtle and exhibit the broadest thermal tolerances (NMFS and USFWS 1998). Leatherback turtles are able to inhabit intensely cold waters for a prolonged period of time because leatherbacks are able to maintain body temperatures several degrees above ambient temperatures. Leatherback turtles are typically associated with continental shelf habitats and pelagic environments, and are sighted regularly in offshore waters (>328 ft). Leatherback turtles regularly occur in deep waters (>328 ft), and an aerial survey study in the north Atlantic Ocean sighted leatherback turtles in water depths ranging from 3 to 13,618 ft, with a median sighting depth of 131.6 ft (CeTAP 1982). This same study found leatherbacks in waters ranging from 7 to 27.2°C.

Life History Information

Although leatherbacks are a long lived species (> 30 years), they are somewhat faster to mature than loggerheads, with an estimated age at sexual maturity reported as about 13-14 years for females, and an estimated minimum age at sexual maturity of 5-6 years, with 9 years reported as a likely minimum (Zug and Parham 1996).

Leatherback sea turtles are predominantly distributed pelagically where they feed on jellyfish such as *Stomolophus*, *Chryaora*, and *Aurelia* (Rebel 1974). Leatherbacks are deep divers, with recorded dives to depths in excess of 1000 m, but they may come into shallow waters if there is an abundance of jellyfish nearshore. They also occur annually in places such as Cape Cod and Narragansett bays during certain times of the year, particularly the fall.

Listing status

The leatherback was listed as endangered on June 2, 1970 and a recovery plan was issued in 1998. Leatherback turtles are included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which effectively bans trade.

Population status and trends

Globally, leatherback turtle populations have been decimated worldwide. The global leatherback turtle population was estimated to number approximately 115,000 adult females in 1980 (Pritchard 1982), but only 34,500 in 1995 (Spotila *et al.* 1996). The decline can be attributed to many factors including fisheries as well as intense exploitation of the eggs (Ross 1979). On some beaches nearly 100% of the eggs laid have been harvested (Eckert 1996). Eckert (1996) and Spotila *et al.* (1996) record that adult mortality has also increased significantly, particularly as a result of driftnet and longline fisheries.

The status of the Atlantic population is not clear. In 1996, it was reported to be stable, at best (Spotila 1996), but numbers in the Western Atlantic at that writing were reported to be on the order of 18,800 nesting females. According to Spotila (pers. com.), the Western Atlantic population currently numbers about 15,000 nesting females, whereas current estimates for the Caribbean (4,000) and the Eastern Atlantic (i.e. off Africa, numbering ~ 4,700) have remained consistent with numbers reported by Spotila *et al.* in 1996. Between 1989 and 1995, marked leatherback returns to the nesting beach at St. Croix averaged only 48.5%, but that the overall nesting population grew (McDonald, *et. al* 1993). This is in contrast to a Pacific nesting beach at Playa Grande, Costa Rica, where only 11.9% of turtles tagged in 1993-94 and 19.0% of turtles tagged in 1994-95 returned to nest over the next five years. Characterizations of this population suggest that it has a very low likelihood of survival and recovery in the wild under current conditions.

Spotila *et al.* (1996) describe a hypothetical life table model based on estimated ages of sexual maturity at both ends of the species' natural range (5 and 15 years). The model concluded that leatherbacks maturing in 5 years would exhibit much greater population fluctuations in response to external factors than would turtles that mature in 15 years. Furthermore, the simulations indicated that leatherbacks could maintain a stable population only if both juvenile and adult survivorship remained high, and that if other life history stages (i.e. egg, hatchling, and juvenile) remained static, stable leatherback populations could not withstand an increase in adult mortality above natural background levels without decreasing.

Threats

The primary threats to leatherback turtles are entanglement in fishing gear (e.g., gillnets, longlines, lobster pots, weirs), boat collisions, and ingestion of marine debris (NMFS and USFWS 1997). The foremost threat is the number of leatherback turtles killed or injured in fisheries. Spotila (2000) states that a conservative estimate of annual leatherback fishery-related mortality (from longlines, trawls and gillnets) in the Pacific during the 1990s is 1,500 animals. He estimates that this represented about a 23% mortality rate (or 33% if most mortality was focused on the East Pacific population). As noted above, leatherbacks normally live at least 30 years, usually maturing at about 12-13 years. Such long-lived species cannot withstand such high rates of anthropogenic mortality.

Blue Whale (*Balenoptera musculus*)

Species description and distribution

Blue whales are the largest living mammal species. They may measure over 30 meters in length and weigh up to 160 metric tons. They are blue-gray in color with distinct gray and white mottling, while their ventral surface may be light pink in coloration. Their dorsal fin is relatively small. Like other baleen whales, they have fringed baleen plates instead of teeth, and ventral grooves which filter large quantities of water during feeding. Blue whales are found in all major oceans, including the continental shelf in coastal shelves and far offshore in pelagic environments of the North Pacific.

At least three subspecies of blue whales have been identified based on body size and geographic distribution (*B. musculus intermedia*, which occurs in the higher latitudes of the Southern Oceans, *B. m. musculus*, which occurs in the Northern Hemisphere, and *B. m. brevicauda* which occurs in the mid-latitude waters of the

southern Indian Ocean and north of the Antarctic convergence), but this consultation will treat them as a single entity.

Blue whales are found in the Atlantic Ocean from the Arctic to at least the mid-latitude waters of the North Atlantic with occasional occurrences in the U.S. EEZ (CeTAP 1982, Wenzel *et al.* 1988, Yochem and Leatherwood 1985, Gagnon and Clark 1993). Blue whales are most frequently sighted off eastern Canada. During winter, they are found in the waters off Newfoundland. In summer, they are found in Davis Strait (Mansfield 1985), in the Gulf of St. Lawrence (from the north shore of the St. Lawrence River estuary to the Strait of Belle Isle), and off eastern Nova Scotia (Sears *et al.* 1987). Blue whales have been sighted off the Azores Islands, but Reiner *et al.* (1993) do not consider them common in that area.

In the Atlantic Ocean, blue whales are found from the Arctic to least the mid-latitude waters of the North Atlantic (CeTAP 1982, Wenzel *et al.* 1988, Yochem and Leatherwood 1985, Gagnon and Clark 1993). The IWC treats these whales as one stock (Donovan 1991).

Sightings of blue whales occur most frequently off eastern Canada. During winter, they are found in the waters off Newfoundland. In summer, they are found in Davis Strait (Mansfield 1985), in the Gulf of St. Lawrence (from the north shore of the St. Lawrence River estuary to the Strait of Belle Isle), and off eastern Nova Scotia (Sears *et al.* 1987).

In 1992, the U.S. Navy conducted an extensive acoustic survey of the North Atlantic using the Integrated Underwater Surveillance System's (IUSS) fixed acoustic array system (Clark 1995). This study gave researchers insight into the seasonality of baleen whale vocalizations (Clark *et al.* 1993). Concentrations of blue whale sounds were detected in the Grand Banks off Newfoundland and west of the British Isles. In the lower latitudes, one blue whale was tracked acoustically for 43 days, during which time the animal traveled 1400 nautical miles around the western North Atlantic from waters northeast of Bermuda to the southwest and west of Bermuda (Gagnon and Clark 1993).

Life history information

Blue whale reproductive activities occur primarily in winter (see Yochem and Leatherwood 1985). Gestation takes 10-12 months, followed by a nursing period that continues for about 6-7 months. They reach sexual maturity at about 5 years of age (see Yochem and Leatherwood 1985). The age distribution of blue whales is unknown and little information exists on natural sources of mortality (such as disease) and mortality rates. Killer whales are known to attack blue whales, but the rate of these attacks or their effect on blue whale populations is unknown. Important foraging areas include the edges of continental shelves and ice edges in polar regions (Yochem and Leatherwood 1985; Reilly and Thayer 1990). Data indicate that some summer feeding takes place at low latitudes in upwelling-modified waters (Reilly and Thayer 1990), and that some whales remain year-round at either low or high latitudes (Yochem and Leatherwood 1985; Clark and Charif 1998). The species *Thysanoëssa inermis*, *T. longipes*, *T. raschi*, and *Nematoscelis megalops* have been listed as prey of blue whales in the North Pacific (Kawamura 1980; Yochem and Leatherwood 1985).

Although some stomachs of blue whales have been found to contain a mixture of euphausiids and copepods or amphipods (Nemoto 1957; Nemoto and Kawamura 1977), it is likely that the copepods and amphipods were consumed adventitiously or incidentally. Reports that blue whales feed on small, schooling fish and squid in the western Pacific (Mizue 1951; Sleptsov 1955) have been interpreted as suggesting that the zooplankton blue whales prefer are less available there (Nemoto 1957). Between February and April, blue whales in the Gulf of California, Mexico, have been observed feeding on euphausiid surface swarms (Sears 1990) consisting mainly of *Nyctiphanes simplex* engaged in reproductive activities (Gendron 1990, 1992).

Sears (1990) regarded *Nyctiphanes simplex* as the principal prey of blue whales in the region, and results from recent fecal analyses confirmed this assertion (Gendron and Del Angel-Rodriguez 1997). However, this phenomenon appears to be strongly influenced by the occurrence of El Niño Southern Oscillation (ENSO) events (Gendron and Sears 1993).

Other baleen whales whose range overlaps with the range of blue whales could potentially compete with blue whales for food (Nemoto 1970). Nevertheless, there is no evidence of competition among these whales and the highly migratory behavior of blue whales may help them avoid competition with other baleen whales (Clapham and Brownell 1996).

Diving and social behavior

Generally, blue whales make 5-20 shallow dives at 12-20 second intervals followed by a deep dive of 3-30 minutes (Mackintosh 1965; Leatherwood *et al.* 1976; Maser *et al.* 1981; Yochem and Leatherwood 1985; Strong 1990; Croll *et al.* 1999). Croll *et al.* (1999) found that the dive depths of blue whales foraging off the coast of California during the day averaged 132 m (433 ft) with a maximum-recorded depth of 204 m (672 ft) and mean dive duration of 7.2 minutes. Nighttime dives are generally less than 50 m (165 ft) in depth (Croll *et al.* 1999).

Blue whales are usually found swimming alone or in groups of two or three (Ruud 1956; Slijper 1962; Nemoto 1964; Mackintosh 1965; Pike and MacAskie 1969; Aguayo 1974). However, larger foraging aggregations and aggregations mixed with other rorquals such as fin whales are regularly reported (Schoenherr 1991; Fiedler *et al.* 1998; Croll and Tershy pers. obs.). Little is known of the mating behavior of blue whales.

Vocalizations and hearing

Known vocalizations of blue whales include a variety of sounds described as low frequency moans or long pulses (Cummings and Thompson 1971, 1977; Edds 1982, Thompson and Friedl 1982; Edds-Walton 1997). Blue whales produce a variety of low frequency sounds in the 10-100 Hz band (Cummings and Thompson 1971; Edds 1982; Thompson and Friedl 1982; McDonald *et al.* 1995; Clark and Fristrup 1997; Rivers 1997; Ljungblad *et al.* in press). The most typical signals are very long, patterned sequences of tonal infrasonic sounds in the 15-40 Hz range. The sounds last several tens of seconds. Estimated source levels are as high as 180-190 dB (Cummings and Thompson 1971). Ketten (1997) reports the frequencies of maximum energy between 12 and 18 Hz. In temperate waters, intense bouts of long patterned sounds are very common from fall through spring, but these also occur to a lesser extent during the summer in high latitude feeding areas. Short sequences of rapid calls in the 30-90 Hz band are associated with animals in social groups (Clark pers. obs., McDonald pers. comm.). The seasonality and structure of long patterned sounds suggest that these sounds are male displays for attracting females and/or competing with other males. The context for the 30-90 Hz calls suggests that they are communicative but not related to a reproductive function. Vocalizations attributed to blue whales have been recorded in presumed foraging areas, along migration routes, and during the presumed breeding season (Beamish and Mitchell 1971; Cummings and Thompson 1971, 1977, 1994; Cummings and Fish 1972; Thompson *et al.* 1996; Rivers 1997; Tyack and Clark 1997; Clark *et al.* 1998).

Blue whale moans within the low frequency range of 12.5-200 Hz, with pulse duration up to 36 seconds, have been recorded off Chile (Cummings and Thompson 1971). A short, 390 Hz pulse also is produced during the moan. One estimate of the overall source level was as high as 188 dB, with most energy in the 1/3-octave bands centered at 20, 25, and 31.5 Hz, and also included secondary components estimates near 50 and 63 Hz (Cummings and Thompson 1971). The function of vocalizations produced by blue whales is unknown. Hypothesized functions include: 1) maintenance of inter-individual distance, 2) species and individual recognition, 3) contextual information transmission (e.g., feeding, alarm, courtship), 4) maintenance of social

organization (e.g., contact calls between females and offspring), 5) location of topographic features, and 6) location of prey resources (review by Thompson *et al.* 1979). Responses to conspecific sounds have been demonstrated in a number of mysticetes, and there is no reason to believe that blue whales do not communicate similarly (Edds-Walton 1997). The low-frequency sounds produced by blue whales can, in theory, travel long distances, and it is possible that such long-distance communication occurs (Payne and Webb 1971; Edds-Walton 1997). The long range sounds may also be used for echolocation in orientation or navigation (Tyack 1999).

Cetaceans have an auditory anatomy that follows the basic mammalian pattern, with some modifications to adapt to the demands of hearing in the sea. The typical mammalian ear is divided into the outer ear, middle ear, and inner ear. The outer ear is separated from the inner ear by the tympanic membrane, or eardrum. In terrestrial mammals, the outer ear, eardrum, and middle ear function to transmit airborne sound to the inner ear, where the sound is detected in a fluid. Since cetaceans already live in a fluid medium, they do not require this matching, and thus do not have an air-filled external ear canal. The inner ear is where sound energy is converted into neural signals that are transmitted to the central nervous system via the auditory nerve. Acoustic energy causes the basilar membrane in the cochlea to vibrate. Sensory cells at different positions along the basilar membrane are excited by different frequencies of sound (Tyack 1999). Baleen whales have inner ears that appear to be specialized for low-frequency hearing.

In a study of the morphology of the blue whale auditory apparatus, Ketten (1997) hypothesized that blue whales have acute infrasonic hearing. No studies have directly measured the sound sensitivity of blue whales.

Listing status

Blue whales have been listed as endangered under the ESA since 1973. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for blue whales.

Population status and trends

The global population of blue whales has been estimated to range from 11,200 to 13,000 animals (Maser *et al.* 1981; U. S. Department of Commerce 1983) which is a fraction of pre-whaling populations estimates of 200,000 animals. The size of the blue whale population in the north Atlantic is also uncertain. The population has been estimated from a few hundred individuals (Allen 1970; Mitchell 1974) to 1,000 to 2,000 individuals (Sigurjónsson 1995). Gambell (1976) estimated there were between 1,100 and 1,500 blue whales in the North Atlantic before whaling began and Braham (1991) estimated there were between 100 and 555 blue whales in the North Atlantic during the late 1980s and early 1990s.

Sears *et al.* (1987) identified over 300 individual blue whales in the Gulf of St. Lawrence, which provides a minimum estimate for their population in the North Atlantic. Sigurjónsson and Gunnlaugson (1990) concluded that the blue whale population had been increasing since the late 1950s; from 1979 to 1988, they concluded that the blue whale population was increasing at an annual rate of about 5 percent.

Threats

From 1889 to 1965 approximately 5,761 blue whales were taken from the North Pacific Ocean (NMFS 1998). Evidence of a population decline can be seen in the catch data from Japan. In 1912, 236 blue whales were caught, 58 whales in 1913, 123 whales in 1914, and from 1915 to 1965, the catch numbers declined continuously (Mizroch *et al.* 1984a). In the eastern North Pacific, 239 blue whales were taken off the California coast in 1926. And, in the late 1950s and early 1960s, Japan caught 70 blue whales per year off the Aleutian Islands (Mizroch *et al.* 1984a). The IWC banned commercial whaling in the North Pacific in 1966, since that time there have been no reported blue whale takes. Nevertheless, Soviet whaling probably continued

after the ban so Soviet catch reports under-represent the number of blue whales killed by whalers (as cited in Forney and Brownell 1996). Surveys conducted in these former-whaling areas in the 1980s and 1990s failed to find any blue whales (Forney and Brownell 1996).

There are no reports of fisheries-related mortality or serious injury in any of the blue whale stocks. Blue whale interaction with fisheries may go undetected because the whales are not observed after they swim away with a portion of the net. However, fishers report that large blue and fin whales usually swim through their nets without entangling and with very little damage to the net (Barlow *et al.* 1997).

In 1980, 1986, 1987, and 1993, ship strikes have been implicated in the deaths of blue whales off California (Barlow *et al.* 1997). In addition, several photo-identified blue whales from California waters were observed with large scars on their dorsal areas that may have been caused by ship strikes. Studies have shown that blue whales respond to approaching ships in a variety of ways, depending on the behavior of the animals at the time of approach, and speed and direction of the approaching vessel. While feeding, blue whales react less rapidly and with less obvious avoidance behavior than whales that are not feeding (Sears *et al.* 1983). Within the St. Lawrence Estuary, blue whales are believed to be affected by large amounts of recreational and commercial vessel traffic. Blue whales in the St. Lawrence appeared more likely to react to these vessels when boats made fast, erratic approaches or sudden changes in direction or speed (Edds and Macfarlane 1987, Macfarlane 1981). The number of blue whales struck and killed by ships is unknown because the whales do not always strand or examinations of blue whales that have stranded did not identify the traumas that could have been caused by ship collisions. In the California/Mexico stock, annual incidental mortality due to ship strikes averaged 0.2 whales during 1991-1995 (Barlow *et al.* 1997), but we cannot determine if this reflects the actual number of blue whales struck and killed by ships.

Humpback Whale (*Balaenoptera physalus*)

Species description and distribution

Humpback whales typically migrate between tropical/sub-tropical and temperate/polar latitudes. Humpback whales feed on krill and small schooling fish on their summer grounds. The whales occupy tropical areas during winter months when they are breeding and calving, and polar areas during the spring, summer, and fall, when they are feeding, primarily on small schooling fish and krill (Caldwell and Caldwell 1983).

In the Atlantic Ocean, humpback whales feed in the northwestern Atlantic during the summer months and migrate to calving and mating areas in the Caribbean. Six separate feeding areas are utilized in northern waters after their return. This area will not be affected because it is within the biologically important area defined by the 200-m (656-ft) isobath on the North American east coast. Humpback whales also use the mid-Atlantic as a migratory pathway and apparently as a feeding area, at least for juveniles. Since 1989, observations of juvenile humpbacks in that area have been increasing during the winter months, peaking January through March (Swingle *et al.* 1993). Biologists theorize that non-reproductive animals may be establishing a winter-feeding range in the Mid-Atlantic since they are not participating in reproductive behavior in the Caribbean. They feed on a number of species of small schooling fishes, particularly sand lance and Atlantic herring, by targeting fish schools and filtering large amounts of water for the associated prey. Humpback whales have also been observed feeding on krill.

Life history information

Humpback whale reproductive activities occur primarily in winter. They become sexually mature at age four to six. Annual pregnancy rates have been estimated at about 0.40-0.42 (NMFS unpublished and Nishiwaki 1959). Cows will nurse their calves for up to 12 months. The age distribution of the humpback whale

population is unknown, but the portion of calves in various populations has been estimated at about 4-12% (Chittleborough 1965, Whitehead 1982, Bauer 1986, Herman *et al.* 1980, and Clapham and Mayo 1987).

The information available does not identify natural causes of death among humpback whales or their number and frequency over time, but potential causes of natural mortality are believed to include parasites, disease, predation (killer whales, false killer whales, and sharks), biotoxins, and entrapment in ice.

Humpback whales exhibit a wide range of foraging behaviors, and feed on a range of prey types including small schooling fishes, euphausiids, and other large zooplankton. Fish prey in the North Pacific include herring, anchovy, capelin, pollack, Atka mackerel, eulachon, sand lance, pollack, Pacific cod, saffron cod, arctic cod, juvenile salmon, and rockfish. In the waters west of the Attu Islands and south of Amchitka Island, Atka mackerel were preferred prey of humpback whales (Nemoto 1957). Invertebrate prey includes euphausiids, mysids, amphipods, shrimps, and copepods.

Diving and social behavior

In Hawaiian waters, humpback whales remain almost exclusively within the 1820 m isobath and usually within 182 m. Maximum diving depths are approximately 150 m (492 ft) (but usually <60 m [197 ft]), with a very deep dive (240 m [787 ft]) recorded off Bermuda (Hamilton *et al.* 1997). They may remain submerged for up to 21 min (Dolphin 1987). Dives on feeding grounds ranged from 2.1-5.1 min in the north Atlantic (Goodyear unpubl. manus.). In southeast Alaska average dive times were 2.8 min for feeding whales, 3.0 min for non-feeding whales, and 4.3 min for resting whales (Dolphin 1987). In the Gulf of California humpback whale dive times averaged 3.5 min (Strong 1989). Because most humpback prey is likely found above 300 m depths most humpback dives are probably relatively shallow.

Clapham (1986) reviewed the social behavior of humpback whales. They form small unstable groups during the breeding season. During the feeding season they form small groups that occasionally aggregate on concentrations of food. Feeding groups are sometimes stable for long periods of time. There is good evidence of some territoriality on feeding grounds (Clapham 1994, 1996), and on wintering ground (Tyack 1981). On the breeding grounds males sing long complex songs directed towards females, other males or both. The breeding season can best be described as a floating lek or male dominance polygyny (Clapham 1996). Intermale competition for proximity to females can be intense as expected by the sex ratio on the breeding grounds that may be as high as 2.4:1.

Vocalizations and hearing

Humpbacks produce a wide variety of sounds. During the breeding season males sing long, complex songs, with frequencies in the 25-5000 Hz range and intensities as high as 181 dB (Payne 1970; Winn *et al.* 1970a; Thompson *et al.* 1986). Source levels average 155 dB and range from 144 to 174 dB (Thompson *et al.* 1979). The songs appear to have an effective range of approximately six to 12 miles (10 to 20 km). Animals in mating groups produce a variety of sounds (Tyack 1981; Tyack and Whitehead 1983, Silber 1986). Sounds are produced less frequently on the summer feeding grounds. Feeding groups produce distinctive sounds ranging from 20 Hz to 2 kHz, with median durations of 0.2-0.8 sec and source levels of 175-192 dB (Thompson *et al.* 1986). These sounds are attractive and appear to rally animals to the feeding activity (D=Vincent *et al.* 1985; Sharpe and Dill 1997). In summary, humpback whales produce at least three kinds of sounds: 1) complex songs with components ranging from at least 20Hz to 4 kHz with estimated source levels from 144 to 174 dB, which are mostly sung by males on the breeding grounds (Payne 1970; Winn *et al.* 1970a; Richardson *et al.* 1995); 2) social sounds in the breeding areas that extend from 50Hz to more than 10 kHz with most energy below 3kHz (Tyack and Whitehead 1983, Richardson *et al.* 1995); and 3) Feeding area vocalizations that are less frequent, but tend to be 20Hz to 2 kHz with estimated source levels in excess of

175 dB re 1 μ Pa-m (Thompson *et al.* 1986; Richardson *et al.* 1995). Sounds often associated with possible aggressive behavior by males (Tyack 1983; Silber 1986) are quite different from songs, extending from 50 Hz to 10 kHz (or higher), with most energy in components below 3 kHz. These sounds appear to have an effective range of up to 9 km (Tyack and Whitehead 1983). A general description of the anatomy of the ear for cetaceans is provided in the description of the blue whale above. Humpback whales respond to low frequency sound. Humpback whales have been known to react to low frequency industrial noises at estimated received levels of 115 to 124 dB (Malme *et al.* 1985), and to conspecific calls at received levels as low as 102dB (Frankel *et al.* 1995). Humpback whales apparently reacted to 3.1 to 3.6 kHz sonar by changing behavior (Maybaum 1990 1993). Malme *et al.* (1985) found no clear response to playbacks of drill ship and oil production platform noises at received levels up to 116dB re 1 μ Pa. Studies of reactions to airgun noises were inconclusive (Malme *et al.* 1985). Humpback whales on the breeding grounds did not stop singing in response to underwater explosions (Payne and McVay 1971). Humpback whales on feeding grounds did not alter short-term behavior or distribution in response to explosions with received levels of about 150dB re 1 μ Pa/Hz at 350Hz (Lien *et al.* 1993; Todd *et al.* 1996). However, at least two individuals were likely killed by the highintensity, impulsed blasts and had extensive mechanical injuries in their ears (Ketten *et al.* 1993; Todd *et al.* 1996). The explosions may also have increased the number of humpback whales entangled in fishing nets (Todd *et al.* 1996). Frankel and Clark (1998) showed that breeding humpbacks showed only a slight statistical reaction to playback of 60 to 90 Hz bounds with a received level of up to 190 dB. While these studies have shown short-term behavioral reactions to boat traffic and playbacks of industrial noise, the potential for habituation, and thus the longterm effects of these disturbances are not known.

Listing status

Humpback whales were listed as endangered under the ESA in 1973. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for the species.

Population status and trends

New information has become available on the status and trends of the humpback whale population in the North Atlantic (NMFS, 2001). Although current and maximum net productivity rates are unknown at this time, the population is apparently increasing. It has not yet been determined whether this increase is uniform across all six feeding stocks (Waring *et al. in prep.*). Katona and Beard (1990) estimated the rate of increase at 9.0 percent, while Barlow and Clapham (1997) reported a 6.5 percent rate for the Gulf of Maine using data through 1991. The rate reported by Barlow and Clapham (1997) may roughly approximate the rate of increase for the portion of the population within the action area. The best estimate of abundance for the North Atlantic humpback whale population is 10,600 animals (CV=0.067; Smith *et al.* 1999), while the minimum population estimate used for NMFS management purposes is 10,019 animals (CV = 0.067; Waring *et al. in prep.*). The Northeast Fisheries Science Center is considering recommending that NMFS identify the Gulf of Maine feeding stock as the management stock for this population in U.S. waters. A population estimate for the Gulf of Maine portion of the population is not available.

Impacts of human activity on this species

In the 1990s, no more than 3 humpback whales were killed annually in U.S. waters by commercial fishing operations in the Atlantic and Pacific Oceans. Between 1990 and 1997, no humpback whale deaths have been attributed to interactions with groundfish trawl, longline and pot fisheries in the Bering Sea, Aleutian Islands, and Gulf of Alaska (Hill and DeMaster 1999). Humpback whales have been injured or killed elsewhere along the mainland U.S. and Hawaii (Barlow *et al.* 1997). In 1991, a humpback whale was observed entangled in longline gear and released alive (Hill *et al.* 1997). In 1995, a humpback whale in Maui waters was found

trailing numerous lines (not fishery-related) and entangled in mooring lines. The whale was successfully released, but subsequently stranded and was attacked and killed by tiger sharks in the surf zone.

Humpback whales seem to respond to moving sound sources, such as whale-watching vessels, fishing vessels, recreational vessels, and low-flying aircraft (Beach and Weinrich 1989, Clapham *et al.* 1993, Atkins and Swartz 1989). Their responses to noise are variable and have been correlated with the size, composition, and behavior of the whales when the noises occurred (Herman *et al.* 1980, Watkins *et al.* 1981, Krieger and Wing 1986). Several investigators have suggested that noise may have caused humpback whales to avoid or leave feeding or nursery areas (Jurasz and Jurasz 1979b, Dean *et al.* 1985), while others have suggested that humpback whales may become habituated to vessel traffic and its associated noise. Still other researchers suggest that humpback whales may become more vulnerable to vessel strikes once they habituate to vessel traffic (Swingle *et al.* 1993; Wiley *et al.* 1995).

Many humpback whales are killed by ship strikes along both coasts of the U.S. On the Atlantic coast, 6 out of 20 humpback whales stranded along the mid-Atlantic coast showed signs of major ship strike injuries (Wiley *et al.* 1995). Almost no information is available on the number of humpback whales killed or seriously injured by ship strikes outside of U.S. waters.

Sperm Whale (*Physeter macrocephalus*)

Species description and distribution

Sperm whales are distributed in the entire world's oceans. Sperm whales have a strong preference for the 3,280 ft (1,000 m) depth contour and seaward. Berzin (1971) reported that they are restricted to waters deeper than 300 m (984 ft), while Watkins (1977) and Reeves and Whitehead (1997) reported that they are usually not found in waters less than 3,281 ft (1,000m) deep. While deep water is their typical habitat, sperm whales have been observed near Long Island, NY, in waters of 41-55 m (135-180 ft) (Scott and Sadove 1997). When found relatively close to shore, sperm whales are usually associated with sharp increases in bottom depth where upwelling occurs and biological production is high, implying the presence of a good food supply (Clarke 1956). They can dive to depths of at least 2000 m (6562 ft), and may remain submerged for an hour or more (Watkins *et al.* 1993). Sperm whales feed primarily on buoyant, relatively slow-moving squid (Clark *et al.* 1993), but may also eat a variety of fish, including salmon (*Oncorhynchus* spp.), rockfish (*Sebastes* spp.), and lingcod (*Ophiodon elongatus*) (Caldwell and Caldwell 1983).

In the Atlantic Ocean, NMFS' most recent stock assessment report notes that sperm whales are distributed in a distinct seasonal cycle, concentrated east-northeast of Cape Hatteras in winter and shifting northward in spring when whales are found throughout the Mid-Atlantic Bight. Distribution extends further northward to areas north of Georges Bank and the Northeast Channel region in summer and then south of New England in fall, back to the Mid-Atlantic Bight. There is also a very large population of sperm whales found in the Gulf of Mexico near the Mississippi River delta.

Life history information

Female sperm whales take about 9 years to become sexually mature (Kasuya 1991, as cited in Perry *et al.* 1999). Male sperm whales take between 9 and 20 years to become sexually mature, but will require another 10 years to become large enough to successfully compete for breeding rights (Kasuya 1991). Adult females give birth after about 15 months gestation and nurse their calves for 2 - 3 years. The calving interval is estimated to be about four to six years (Kasuya 1991). The age distribution of the sperm whale population is unknown, but sperm whales are believed to live at least 60 years (Rice 1978). Estimated annual mortality rates

of sperm whales are thought to vary by age, but previous estimates of mortality rate for juveniles and adults are now considered unreliable (IWC 1980, as cited in Perry *et al.* 1999). Sperm whales are known for their deep foraging dives (in excess of 3 km). They feed primarily on mesopelagic squid, but also consume octopus, other invertebrates, and fish (Tomilin 1967, Tarasevich 1968, Berzin 1971). Perez (1990) estimated that their diet in the Bering Sea was 82% cephalopods (mostly squid) and 18% fish. Fish eaten in the North Pacific included salmon, lantern fishes, lancetfish, Pacific cod, pollack, saffron cod, rockfishes, sablefish, Atka mackerel, sculpins, lumpsuckers, lamprey, skates, and rattails (Tomilin 1967, Kawakami 1980, Rice 1986b). Sperm whales taken in the Gulf of Alaska in the 1960s had fed primarily on fish. Daily food consumption rates for sperm whales ranges from 2 - 4% of their total body weight (Lockyer 1976b, Kawakami 1980). Potential sources of natural mortality in sperm whales include killer whales and papilloma virus (Lambertson *et al.* 1987).

Diving and social behavior

Sperm whales are likely the deepest and longest diving mammals. Typical foraging dives last 40 min and descend to about 400m followed by approximately 8 min of resting at the surface (Gordon 1987; Papastavrou *et al.* 1989). However, dives of over 2 hr and as deep as 3,000 m have been recorded (Clarke 1976; Watkins *et al.* 1985). Descent rates recorded from echosounders were approximately 1.7m/sec and nearly vertical (Goold and Jones 1995). There are no data on diurnal differences in dive depths in sperm whales. However, like most diving vertebrates for which there is data (e.g. rorqual whales, fur seals, chinstrap penguins), sperm whales probably make relatively shallow dives at night when organisms from the ocean's deep scattering layers move toward the ocean's surface.

The groups of closely related females and their offspring develop dialects specific to the group (Weilgart and Whitehead 1997) and females other than birth mothers will guard young at the surface (Whitehead 1996b) and will nurse young calves (Reeves and Whitehead 1997).

Vocalizations and hearing

Sperm whales produce loud broadband clicks from about 0.1 to 20 kHz (Weilgart and Whitehead 1993, 1997; Goold and Jones 1995). These have source levels estimated at 171 dB re 1 μ Pa (Levenson 1974). Current evidence suggests that the disproportionately large head of the sperm whale is an adaptation to produce these vocalizations (Norris and Harvey 1972; Cranford 1992; but see Clarke 1979). This suggests that the production of these loud low frequency clicks is extremely important to the survival of individual sperm whales. The function of these vocalizations is relatively well studied (Weilgart and Whitehead 1993, 1997; Goold and Jones 1995). Long series of monotonous regularly spaced clicks are associated with feeding and are thought to be produced for echolocation. Distinctive, short, patterned series of clicks, called codas, are associated with social behavior and intragroup interactions; they are thought to facilitate intra-specific communication, perhaps to maintain social cohesion with the group (Weilgart and Whitehead 1993).

A general description of the anatomy of the ear for cetaceans is provided in the description of the blue whale above. The only data on the hearing range of sperm whales are evoked potentials from a stranded neonate (Carder and Ridgway 1990). These data suggest that neonatal sperm whales respond to sounds from 2.5-60 kHz. Sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders and submarine sonar (Watkins and Schevill 1975; Watkins *et al.* 1985). They also stop vocalizing for brief periods when codas are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995). Sperm whales have moved out of areas after the start of air gun seismic testing (Davis *et al.* 1995). Seismic air guns produce loud, broadband, impulsive noise (source levels are on the order of 250 dB) with shots at every 15 seconds, 240 shots per hour, 24 hours per day during active tests. Because they spend large amounts of time at depth and use low frequency sound sperm whales are likely to be susceptible to low frequency sound in the ocean (Croll *et al.*

1999). Furthermore, because of their apparent role as important predators of mesopelagic squid and fish, changes in their abundance could affect the distribution and abundance of other marine species.

Listing status

Sperm whales have been protected from commercial harvest by the IWC since 1981, although the Japanese continued to harvest sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). Sperm whales were listed as endangered under the ESA in 1973. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for sperm whales.

Population status and trends

The best abundance estimate that is currently available for the western North Atlantic sperm whale population is 2,698 (CV=0.67) animals, and the minimum population estimate used for NMFS management purposes is 1,617 (CV=0.67) (Waring *et al. in prep.*). Due to insufficient data, no information is available on population trends at this time for the western North Atlantic sperm whale stock.

Impacts of human activity on this species

In U.S. waters in the Pacific, sperm whales are known to have been incidentally taken only in drift gillnet operations, which killed or seriously injured an average of 9 sperm whales per year from 1991-1995 (Barlow *et al.* 1997). Interactions between longline fisheries and sperm whales in the Gulf of Alaska have been reported over the past decade (Rice 1989, Hill and DeMaster 1999). Observers aboard Alaskan sablefish and halibut longline vessels have documented sperm whales feeding on fish caught in longlines in the Gulf of Alaska. During 1997, the first entanglement of a sperm whale in Alaska's longline fishery was recorded, although the animal was not seriously injured (Hill and DeMaster 1998). The available evidence does not indicate sperm whales are being killed or seriously injured as a result of these interactions, although the nature and extent of interactions between sperm whales and long-line gear is not yet clear.

Smalltooth Sawfish (*Pristis pectinata*)

Distribution. The smalltooth sawfish has a circumtropical distribution and has been reported from shallow coastal and estuarine habitats. In U.S. waters, *P. pectinata* historically occurred from North Carolina south through the Gulf of Mexico, where it was sympatric with the largetooth sawfish *P. pristis* (west and south of Port Arthur, TX) (Adams and Wilson, 1995). Individuals have also historically been reported to migrate northward along the Atlantic seaboard in the warmer months. It also was an occasional visitor to waters as far north as New York.

Few individuals are observed outside of peninsular Florida (NMFS, 2000). Records indicate that smalltooth sawfish have been found in the lower reaches of the St. Johns River and the Indian River Lagoon system. At least one recorded observation has occurred to the north of the project area, within the vicinity of Broward County (NMFS, 2000). Florida Museum of Natural History (at University of Florida- Gainesville) data include 13 records of *P. pectinata* from 1912 to 1998 (and one undated record). Nine of these specimens were recorded from the Gulf of Mexico off Florida, three came from the Atlantic side of Florida, and one animal was caught in Pacific waters off Ecuador. Three additional records of smalltooth sawfish from the Atlantic coast of Florida have yet to be cataloged in this collection: one specimen is from 1979; the second is not dated (the Museum received both these fish from the Harbor Branch Oceanographic Institute); a third specimen was landed May 22, 1998 from the

Indian River (Burgess, pers. comm.). There are eight reports of smalltooth sawfish along the Florida east coast in the 1990's, most from coastal rather than lagoon areas.

Natural History. Worldwide, six species of sawfish (family Pristidae) exist, belonging to the genera *Pristis* and *Anoxypristis* (Nelson, 1994). Sawfish are in fact rays (order Rajiformes), but resemble sharks more than other rays due to fin size, orientation, and position. Like rays, however, the trunk and especially the head are vertically flattened. The snout is a long narrow flattened rostral blade with a series of transverse teeth along either edge. The two U.S. Atlantic coast species (both genus *Pristis*) are distinguishable, as the smalltooth sawfish (*P. pectinata*) lacks a distinct lower lobe on the caudal fin (NMFS, 2000).

Robins and Ray (1986) note body length may achieve 5.5 m, whereas largetooth sawfishes may reach 6.1 m. Bigelow and Schroeder (1953) reported litter size of 15-20 embryos. Overall, life history parameters for this species are largely unknown.

The smalltooth sawfish is euryhaline, occurring in fresh water, nearshore estuaries, and coastal waters to depths of 25 meters. In the United States, the smalltooth sawfish is generally a shallow-water fish of inshore bars, mangrove edges, and seagrass beds, but are occasionally found in deeper coastal waters.

Status and Population Trends. The smalltooth sawfish was added to the list of candidate species under the ESA in 1991, removed in 1997, and placed back on the list again in 1999. In November 1999, NMFS received a petition from the Center of Marine Conservation requesting that this species be listed as endangered under the ESA. NMFS completed a status review for smalltooth sawfish in December 2000, and published a proposed rule to list the U.S. population of this species as endangered under the ESA on April 16, 2001. A final rule on this proposal has not been issued as of this date.

According to NMFS (2000), "The U.S. DPS of smalltooth sawfish has experienced a ninety percent curtailment of its range and severe declines in abundance. Agriculture, urban development, commercial activities, channel dredging, boating activities, and the diversion of freshwater run-off have resulted in the destruction and modification of smalltooth habitat throughout the southeastern U.S. Although habitat degradation is not likely the primary reason for the decline of smalltooth sawfish abundance and their contracted distribution, it has likely been a contributing factor. Over 50% of the U.S. human population lives within fifty miles of the ocean or Great Lakes. Migration to the coastlines for home, livelihood or recreation is predicted to increase by the year 2010 (National Ocean Service, 2000). Increases in coastal human populations will likely result in additional losses of marine habitats and increased pollution, further threatening the survival of smalltooth sawfish."

Simpfendorfer (2000) used a demographic approach to estimate intrinsic rate of natural increase and population doubling time. Since there are very limited life history data for smalltooth sawfish, much of the data (e.g. reproductive periodicity, longevity and age-at-maturity) were inferred from the more well-

known largemouth sawfish. The litter size of smallmouth sawfish in the literature is given as 15 – 20 and Simpfendorfer used a mean of 17.5. However, the data on which this litter size is based are somewhat dubious. To account for uncertainty in the life-history parameters several different scenarios were tested, covering longevities from 30 to 70 years and ages-at-maturity from 10 to 27 years. The results indicated that the intrinsic rate of population increase ranged from 0.08/year to 0.13/ year, and population-doubling times ranged from 5.4 years to 8.5 years. These models assume the literature value for litter size is correct; doubling times would be longer if litter sizes are more in the range observed for largemouth sawfish (1 to 13, with a mean of 7.3). Simpfendorfer concluded, “The estimated population doubling times for smallmouth sawfish indicate that the recovery times for this population will be very long. There are no data available on the size of the remaining populations, but anecdotal information indicates that smallmouth sawfish survive today in small fragmented areas where the impact of humans, particularly from net fishing, has been less severe. Fragmenting of the population will increase the time that it takes for recovery since the demographic models used in the study above assume a single inter-breeding population. The genetic effects of recovery from very small population sizes may also impact conservation efforts. It is likely that even if an effective conservation plan can be introduced in the near future, recovery to a level where the risk of extinction is low will take decades, while recovery to pre-European settlement levels would probably take several centuries.”

Threats. The principal habitats for smallmouth sawfish in the southeast U.S. are the shallow coastal areas and estuaries, with some specimens moving upriver in freshwater (Bigelow and Schroeder, 1953). Therefore, the continued urbanization of the southeastern coastal states has resulted in substantial loss of coastal habitat through such activities as agricultural and urban development; commercial activities; dredge and fill operations; boating; erosion and diversions of freshwater run-off (SAFMC, 1998). Smallmouth sawfish may be especially vulnerable to coastal habitat degradation due to their affinity to shallow, estuarine systems. Because of the slow individual growth, late maturation, and low fecundity, long-term commitments to habitat protection are necessary for the eventual recovery of the species. Overfishing and incidental take in nets (due in part to its body size and unusual morphology) are suspected to be strongly linked to population declines (NMFS, 2000). Other details pertaining to the factors contributing to the decline of the smallmouth sawfish can be found in the “Status Review of Smallmouth Sawfish (*Pristis pectinata*)”, (NMFS, 2000) and will not be repeated in detail here.

Critical Habitat. No critical habitat has yet been proposed for the smallmouth sawfish.

Johnson’s Seagrass (*Halophila johnsonii*)

Distribution. *H. johnsonii* has one of the most limited geographic ranges of all seagrass species. The species has only been found growing along approximately 200 km of coastline in southeastern Florida from Sebastian Inlet, Indian River County to northern Key Biscayne, Miami-Dade County (Kenworthy 1997). This narrow range and apparent endemism indicates that Johnson’s seagrass has the most limited geographic distribution of any seagrass in the world.

Johnson's seagrass occurs in dynamic and disjunct patches throughout its range. Growth appears to be rapid and leaf pairs have short life spans while horizontally spreading from dense apical meristems (Kenworthy 1997). Kenworthy suggested that horizontal spreading rapid growth pattern and a high biomass turnover could explain the dynamic patches observed in distribution studies. New information reviewed in Kenworthy (1999, 1997) confirms *H. johnsonii*'s limited geographic distribution in patchy and vertically disjunct areas between Sebastian Inlet and northern Biscayne Bay. Surveys conducted by NMFS Biscayne Bay, Florida Bay, the Florida Keys, outer Florida Bay, Puerto Rico, and the Virgin Islands provided no verifiable sightings of Johnson's seagrass outside of the range already reported. After the completion of many surveys by resource agencies, including those conducted for this project, no *H. johnsonii* has been reported within the action area.

Status and Population Trends. Johnson's Seagrass (*Halophila johnsonii*) was listed as a threatened species by NMFS on September 14, 1998 (63 FR 49035) and a re-proposal to designate critical habitat pursuant to Section 4 of the Endangered Species Act (ESA) was published on December 2, 1998 (64 FR 64231). The final rule for critical habitat designation for *H. johnsonii* was published April 5, 2000 (Federal Register, Vol. 65, No. 66). It is the first marine plant ever listed. Kenworthy (1993, 1997, 1999) discusses the results of the field studies and summarizes an extensive literature review and associated interviews regarding the status of Johnson's seagrass.

There is currently insufficient information to clearly determine trends in the Johnson's seagrass population, which was described in 1980 and has only been extensively studied during the 1990s. Generally, stem densities have declined in some areas and increased in others. Where multiyear mapping studies have been conducted within the Indian River Lagoon, recent increases in Johnson's seagrass have been noted but may be attributed in part to the recent increase in search effort and increased familiarity with this species (Virnstein *et al.* 1997). The authors conclude that from 1994 through 1997, no strong seasonal distribution or increases or decreases in abundance or range can be discerned.

Natural History. The species is perennial and may spread even during winter months under favorable conditions (Virnstein *et al.* 1997). Sexual reproduction in Johnson's seagrass has not been documented. Female flowers have been found; however, dedicated surveys in the Indian River Lagoon have not discovered male flowers, fertilized ovaries, fruits, or seeds either in the field or under laboratory conditions (Jewett-Smith *et al.* 1997). Searches throughout the range of Johnson's seagrass have produced the same results, suggesting that the species does not reproduce sexually or that the male flowers are difficult to observe or describe, as noted for other *Halophila* species (Kenworthy 1997). Surveys to date indicate that the incidence of female flowers appears to be much higher near the inlets leading to the Atlantic Ocean, suggesting that inlet conditions are qualitatively better for flowering than conditions further inshore (Kenworthy pers. comm. 1998). It is possible that male flowers, if they exist, occur near inlets as well. Maintenance of good water quality around inlets may be essential for promoting flowering in the Johnson's seagrass population.

The essential features of habitat appear to be adequate water quality, salinity, water clarity and stable sediments free from physical disturbance. Important habitat characteristics include shallow intertidal as well as deeper subtidal zones (2-5 m). Water transparency appears to be critical for Johnson's seagrass, limiting its distribution at depth to areas of suitable optical water quality (Kenworthy 1997). In areas in which long-term poor water and sediment quality have existed until recently, such as Lake Worth Lagoon, *H. johnsonii* appears to occur in relatively higher abundance perhaps due to the previous inability of the larger species to thrive. These studies support unconfirmed previous observations that suspended solids and tannin, which reduce light penetration and water clarity, may be important factors limiting seagrass distribution. Good water clarity is essential for *Halophila johnsonii* growth in deeper waters.

Johnson's seagrass occurs over varied depths, environmental conditions, salinities, and water quality. In tidal channels *H. johnsonii* is found in coarse sand substrates, although it has been found growing on sandy shoals, in soft mud near canals and rivers where salinity many fluctuate widely (Virnstein *et al.* 1997). Virnstein has called Johnson's seagrass a "perennial opportunistic species." Within his study areas in the Indian River Lagoon, *H. johnsonii* was found by itself, with other seagrass species, in the intertidal, and (more commonly) at the deep edge of some transects in water depths of up to 180 cm. *H. johnsonii* was found shallowly rooted on sandy shoals, in soft mud, near the mouths of canals, rivers and in shallow and deep water (Virnstein *et al.* 1997). Additionally, recent studies have documented large patches of Johnson's seagrass on flood deltas just inside Sebastian Inlet, as well as far from the influence of inlets (reported at the workshop discussed in Kenworthy, 1997). These sites encompass a wide variety of salinities, water quality, and substrates. *Halophila johnsonii* appears to be outcompeted in ideal seagrass habitats where environmental conditions permit the larger species to thrive (Virnstein *et al.* 1997, Kenworthy 1997).

Critical Habitat. The northern and southern ranges of Johnson's seagrass are defined as Sebastian Inlet and central Biscayne Bay, respectively. These limits to the species' range have been designated as critical habitat for Johnson's seagrass. Within its range, Johnson's seagrass critical habitat designations have been designated for 10 areas: a portion of the Indian River Lagoon, north of the Sebastian Inlet Channel; a portion of the Indian River Lagoon, south of the Sebastian Inlet Channel; a portion of the Indian River Lagoon near the Fort Pierce Inlet; a portion of the Indian River Lagoon, north of the St. Lucie Inlet; a portion of Hobe Sound; a site on the south side of Jupiter Inlet; a site in central Lake Worth Lagoon; a site in Lake Worth Lagoon, Boynton Beach; a site in Lake Wyman, Boca Raton; and most of Biscayne Bay south to 25° 45' north latitude (except authorized federal navigational channels).

The Boca Raton and Boynton Beach critical habitats have populations that are distinguished by a higher index of genetic variation than any of the central and northern populations examined to date (Kenworthy, 1999). These two sites represent a genetically semi-isolated group that could be the reservoir of a large part of the overall genetic variation found in the species. Information is still lacking on the geographic extent of this genetic variability.

Threats. The natural history of the species itself makes it especially vulnerable. A factor leading to the listing of *H. johnsonii* is its rareness within its extremely restricted geographic range. Johnson's seagrass is characterized by small size (it is the smallest of all of the seagrasses found within its range, averaging about 3 cm in height), fragile rhizome structure and associated high turnover rate, and is apparently reliant on vegetative means to reproduce, grow and migrate across the sea bottom. These factors make Johnson's seagrass extremely vulnerable to human or environmental impacts by reducing its capacity to repopulate an area once removed. The species and its habitat are impacted by human-related activities throughout the length its range, including bridge construction and dredging, and the species' threatened status produces new and unique challenges for the management of shallow submerged lands. Vessel traffic resulting in propeller and anchor damage, maintenance dredging, dock and marine construction, water pollution, and land use practices could require special management within critical habitat.

Kenworthy (1997, 1999) summarized the newest information on Johnson's seagrass biology, distribution, and abundance and confirmed the limited range and rareness of this species within its range. Additionally, the apparent restriction of propagation through vegetative means suggests that colonization between broadly disjunct areas is likely difficult, suggesting that the species is vulnerable to becoming endangered if it is removed from large areas within its range by natural or anthropogenic means. Human impacts to Johnson's seagrass and its habitat include: (1) Vessel traffic and the resulting propeller dredging and anchor mooring; (2) dredging; (3) dock and marina construction and shading from these structures; (4) water pollution; and (5) land use practices including shoreline development, agriculture, and aquaculture.

Activities associated with recreational boat traffic account for the majority of human use associated with the proposed critical habitat areas. The destruction of the benthic community due to boating activities, propeller dredging, anchor mooring, and dock and marina construction was observed at all sites during a study by NMFS from 1990 to 1992. These activities severely disrupt the benthic habitat, breaching root systems, severing rhizomes, and significantly reducing the viability of the seagrass community. Propeller dredging and anchor mooring in shallow areas are a major disturbance to even the most robust seagrasses. This destruction is expected to worsen with the predicted increase in boating activity. Trampling of seagrass beds, a secondary effect of recreational boating, also disturbs seagrass habitat. Populations of Johnson's seagrass inhabiting shallow water and water close to inlets, where vessel traffic is concentrated, will be most affected.

The constant sedimentation patterns in and around inlets require frequent maintenance dredging, which could either directly remove essential seagrass habitat or indirectly affect it by redistributing sediments, burying plants and destabilizing the bottom structure. Altering benthic topography or burying the plants may remove them from the photic zone. Permitted dredging of channels, basins, and other in- and on-water construction projects cause loss of Johnson's seagrass and its habitat through direct removal of the plant, fragmentation of habitat, and shading. Docking facilities that, upon meeting certain provisions, are exempt from state permitting also contribute to loss of Johnson's seagrass through construction

impacts and shading. Fixed add-ons to exempt docks (such as finger piers, floating docks, or boat lifts) have recently been documented as an additional source of seagrass loss due to shading (Smith and Mezich, 1999).

Decreased water transparency caused by suspended sediments, water color, and chlorophylls could have significant detrimental effects on the distribution and abundance of the deeper water populations of Johnson's seagrass. A distribution survey in Hobe and Jupiter Sounds indicates that the abundance of this seagrass diminishes in the more turbid interior portion of the lagoon where reduced light limits photosynthesis.

Other areas of concern include seagrass beds located in proximity to rivers and canal mouths where low salinity, highly colored water is discharged. Freshwater discharge into areas adjacent to seagrass beds may provoke physiological stress upon the plants by reducing the salinity levels. Additionally, colored waters released into these areas reduce the amount of sunlight available for photosynthesis by rapidly attenuating shorter wavelengths of photosynthetically active radiation. Continuing and increasing degradation of water quality due to increased land use and water management threatens the welfare of seagrass communities. Nutrient overenrichment caused by inorganic and organic nitrogen and phosphorous loading via urban and agricultural land run-off stimulates increased algal growth that may smother Johnson's seagrass, shade rooted vegetation, and diminish the oxygen content of the water. Low oxygen conditions have a demonstrated negative impact on seagrasses and associated communities.

A wide range of activities funded, authorized or carried out by Federal agencies may affect the essential habitat requirements of Johnson's seagrass. These include authorization by the COE for beach nourishment, dredging, and related activities including construction of docks and marinas; bridge construction projects funded by the Federal Highway Administration; actions by the U.S. Environmental Protection Agency and the COE to manage freshwater discharges into waterways; regulation of vessel traffic by the U.S. Coast Guard; management of national refuges and protected species by the U.S. Fish and Wildlife Service; management of vessel traffic (and other activities) by the U.S. Navy; authorization of state coastal zone management plans by NOAA's National Ocean Service, and management of commercial fishing and protected species by NMFS.

Critical habitat. Critical habitat for Johnson's seagrass was finalized on April 5, 2000 (65 FR 17786). Critical habitat ranges from Sebastian Inlet in central Florida south including a portion of Biscayne Bay. Existing federal navigation channels were excluded from the designation. The Corps has reviewed the final rule for critical habitat, and has determined that NMFS did not designate constituent elements to be addressed in assessing modifications to designated critical habitat.

Protective Measures Taken in the Project Area Separate from Conservation Measures the Corps will Undertake as Part of the Proposed Action

State of Florida

The State of Florida maintains the Bill Sadowski Critical Wildlife Area (CWA), which is immediately south of the action area. This CWA utilizes a *No Entry Zone* (for human-exclusion) to preserve marine resources associated with the area. These resources include extensive seagrass beds, which may be utilized by foraging sea turtles. There have been no continuously employed measures specifically designed by the Port of Miami or Miami Dade County for the conservation of sea turtles and the smalltooth sawfish. However, consultations with federal agencies in the prudent planning and implementation of conservation measures have been carried out for decades.

Scientific Research on Sea turtles, Endangered large whales, Johnson's seagrass or smalltooth sawfish

- Regulations developed under the ESA allow for the taking of ESA-listed species for the purposes of scientific research. In addition, the ESA also allows for the taking of listed species by states through cooperative agreements developed per section 6 of the ESA. Prior to issuance of these authorizations for taking, the proposal must be reviewed for compliance with section 7 of the ESA. Permits to conduct scientific research on listed species found in the action area are issued by the NMFS Office of Protected Resources in Silver Spring, Maryland. Currently no research on the listed species found in the action area under NMFS jurisdiction is proposed or underway (Lillian Becker, NMFS- OPR, Silver Spring, 2002 pers.com.).

Other consultations of Federal actions in the area to date

The Corps has been working with the citizens of Miami-Dade County for several years on expanding and maintaining Miami Harbor (Table 3). None of the projects authorized by Congress through 1968 were required to consult under the Endangered Species Act of 1973 (ESA). Miami Harbor projects following implementation of the ESA included a 1980 deepening of a turning basin, for which a Biological Opinion was issued by FWS (August 21, 1980), and the 1990 federal project, for which the FWS issued a Planning Aid Report (December 21, 1987) and a Fish and Wildlife Coordination Act Report (February 9, 1989). Through such coordination, conservation measures have increasingly addressed cumulative project impacts and have been effective in mitigating such effects (see "Conservation Section").

The Corps is also working with Miami-Dade County on an environmental restoration project on Virginia Key, located to the south of the Port. The project is scheduled to begin in fall 2002, and will primarily entail removal of exotic vegetation (sometimes via heavy equipment), planting of native species, and creating a two-acre pond with a surrounding wetland, and restoration of another wetland. The Corps believes that the species addressed in the current biological assessment may be affected, but not adversely affected in any way by the project, as the island interior is inaccessible to them. The NMFS Section 7 consultation on that project (April 8, 2002) stated a finding that that project is not likely to adversely impact Johnson's seagrass or its designated critical habitat (consultation number I/SER/2001/00277).

Another action, the Lummus Island Turning Basin deepening project, is a project with similar risks as the proposed project, but on a much smaller scale (one inshore dredge area) and includes precautions similar to those proposed here for the Miami Harbor deepening/widening project. The Corps has initiated consultation with NMFS on this project under section 7 of the ESA and is currently waiting for either a biological opinion or letter of concurrence from NMFS.

Table 3: Previously Authorized Federal Actions at Miami Harbor

ACTS	WORK AUTHORIZED	DOCUMENTS
13 June 1902	Channel (Government Cut) 18 feet deep across peninsula and north jetty	H. Doc.662/56/1 & A.R. for 1900 p.1987
2 Mar 1907	South Jetty and channel 100 feet wide.	Specified in Act
25 June 1912	Channel 20 feet deep by 300 feet wide and extension of jetties.	H. Doc. 554/62/2
3 Mar 1925	Channel 25 feet deep at entrance and 25 feet deep by 200 feet across Biscayne Bay	H. Doc. 516/67/4
3 Jul 1930	Channel 300 feet wide across Biscayne Bay and enlarging municipal turning basin.	R&H Comm. Doc. 15/71/2
30 Aug 1935	Depth of 30 feet to and in turning basin.	S. Comm. Print 73.2
26 Aug 1937	Widen turning basin 200 feet on south side.	R&H. C. Doc. 86/74/2
2 Mar 1945	Virginia Key Improvement (De-authorized)	S. Doc. 251/79/2
2 Mar 1945	Consolidation of Miami River and Miami Harbor projects; widening at mouth of Miami River (De-authorized); a channel from the mouth of the river to the Intracoastal Waterway (De-authorized); thence a channel from the Intracoastal Waterway to Government Cut (De-authorized); and a channel from Miami River to harbor of refuge in Palmer Lake (De-authorized).	H. Doc. 91/79/1
14 Jul 1960	Channel 400 feet wide across Biscayne Bay; enlarge turning basin 300 feet on south and northeasterly sides; dredge turning basin on north side Fisher Island; de-authorize Virginia Key development.	S. Doc. 71/85/2
13 Aug 1968	Enlarging the existing entrance channel to 38-foot depth and 500-foot width from the ocean to the existing beach line; deepening the existing 400-foot wide channel across Biscayne Bay to 36 feet; and deepening the existing turning basin at Biscayne Boulevard terminal and Fisher Island to 36 feet.	S. Doc. 93/90/2
17 Nov 1986	De-authorized the widening at the mouth of Miami River to existing project widths; and the channels from the mouth of Miami River to the turning basin, to Government Cut, and to a harbor of refuge in Palmer Lake.	Public Law 99-662
28 Nov 1990		Public Law 101-640 11/28/90

	to a depth of 44 ft.; Enlarging Fishermans Channel, south of Lummus Island, to a depth of 42 ft. and a width of 400 ft.; and Constructing a 1600 ft. diameter Turning Basin near the west end of Lummus Island to a depth of 42 ft.	
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Protective Measures Taken in the Project Area as Part of the Proposed Action

Consideration of Plans and Methods to Minimize/Avoid Environmental Impacts. Conservation measures were a major focus during the plan formulation phase for the proposed project. Avoiding and minimizing some potential impact areas significantly decreased the risk of indirect effects on managed and protected species, and a great deal of consideration was given to the utilization of rock removal methods to decrease the likelihood of incidental take, injury, and behavioral modification of protected species. While efforts to reduce impacts to habitats were fruitful, it was determined that rock removal options not involving blasting were possibly more detrimental to populations and individuals of protected species. One alternative option was the use of a punchbarge/piledriver to break rock. However, it was determined that the punchbarge, which would work for 12-hour periods, strikes the rock approximately once every 60-seconds. This constant pounding would serve to disrupt animal behavior in the area. Using the punchbarge would also extend the length of the project, thus increasing any potential impacts to all fish and wildlife resources in the area. The Corps believes that blasting is actually the least environmentally impactful method for removing the rock in the Port. Each blast will last no longer than five (5) seconds in duration, and may even be as short as 2 seconds each. Additionally, the blasts are confined in the rock substrate. Boreholes are drilled into the rock below, the blasting charge is set, and then the chain of explosives is detonated. Because the blasts are confined within the rock structure, the distance of the blast effects are reduced as compared to an unconfined blast (see discussion below).

Development of Protective Measures. The proposed project includes measures to conserve sperm and humpback whale, sea turtles and smalltooth sawfish. Foremost among the measures are protective actions to ensure that sea turtles and smalltooth sawfish are not killed and whales are not harassed due to blasting activities, if in fact such methods are required as a part of the overall dredging operation. Development of the measures involved consideration of past practices and operations, anecdotal observations, and the most current scientific data. The discussion below summarizes the development of the conservation measures, which, although developed for marine mammals, will also be utilized to protect such species as sea turtles and smalltooth sawfish.

Blasting

To achieve the deepening of the Port of Miami from the existing depth of -42 feet to project depth of -50 feet, pretreatment of the rock areas may be required. Blasting is anticipated to be required for some or all of the deepening and extension of the channel, where standard construction methods are unsuccessful. The total volume to be removed in these areas is up to 4.1 million cubic yards. The work may be completed in the following manner:

Contour dredging with either bucket, hydraulic or excavator dredges to remove material that can be

dredged conventionally and determine what areas require blasting.

Pre-treating (blasting) the remaining above grade rock, drilling and blasting the "Site Specific" areas where rock could not be conventionally removed by the dredges.

Excavating with bucket, hydraulic or excavator dredges to remove the pre-treated rock areas to grade.

All drilling and blasting will be conducted in strict accordance with local, state and federal safety procedures. Marine Wildlife Protection, Protection of Existing Structures, and Blasting Programs coordinated with federal and state agencies.

Based upon industry standards and USACE, Safety & Health Regulations, the blasting program may consist of the following:

The weight of explosives to be used in each blast will be limited to the lowest poundage (~90 lbs. or less) of explosives that can adequately break the rock. The blasting would consist of up to 3 blasts per day, preparing for removal of approximately 1500 cubic yards per blast. This equates to about 1550 blast days to complete the project (based on an assumption of one drillboat, and assuming that the entire project area will require blasting).

The following safety conditions are standard in conducting underwater blasting:

- Drill patterns are restricted to a minimum of 8 ft separation from a loaded hole.
- Hours of blasting are restricted from 2 hours after sunrise to 1 hour before sunset to allow for adequate observation of the project area for protected species.
- Selection of explosive products and their practical application method must address vibration and air blast (overpressure) control for protection of existing structures and marine wildlife.
- Loaded blast holes will be individually delayed to reduce the maximum pounds per delay at point detonation, which in turn will reduce the mortality radius.
- The blast design will consider matching the energy in the "work effort" of the borehole to the rock mass or target for minimizing excess energy vented into the water column or hydraulic shock.

Because of the potential duration of the blasting and the proximity of the inshore blasting to a Critical Wildlife Area, a number of issues will need to be addressed. One of the key issues is the extent of a safety radius for the protection of marine wildlife. This is the distance from the blast site which any protected species must be in order to commence blasting operations. Ideally the safety radius is large enough to offer a wide buffer of protection for marine animals while still remaining small enough that the area can be intensely surveyed

There are a number of methods that can be used to calculate a safety radius. Little published data exists

for actual measurements of sub aqueous blasts confined to a rock layer and their impacts to marine mammals or turtles. There is some information on the impacts to fish from similar blasts. Both literature searches and actual observations from similar blasting events will be used as a guide in establishing a safety radius that affords the best protection from lethal harm to marine wildlife. The following will be considered in establishing the radius for blasting inshore of the outer reef:

The U.S. Navy Dive Manual and the FFWCC Endangered Species Watch Manual the safety formula for an uncontrolled blast suspended in the water column, which is as follows:

$R = 260 (\text{cube root } w)$

R = Safety radius

W = Weight of explosives

This formula is a conservative for the blasting being done in the Port of Miami since the blast will be confined within the rock and not suspended in the water column.

For blasting on the outer reef, the Corps proposes to use aerial and passive acoustic surveys to determine if there are sperm or humpback whales within a 1-nautical mile (nm) radius of the project area. In the Biological Opinion for the shock trial of the Winston Churchill (DDG-81) (NMFS, 2000b), NMFS required the Navy to establish a zone of 3 nm for acoustic monitoring and 2 nm for aerial monitoring for three 10,000 lb open water unconfined explosions. Blasting for the channel extension will utilize confined blasts drilled into the substrate, and as a result the Corps believes that any acoustic or pressure effects to the project area will be substantially less than those evaluated by NMFS in setting the safety zones for the Churchill tests.

Utilizing data from rock-contained blasts such as those at Atlantic Dry Dock and Wilmington, North Carolina, the Corps has been able to estimate potential effects on protected species. These data can be correlated to the biological opinion issued on October 10, 2000 by NMFS for the incidental taking of listed marine mammals for the explosive shock testing of the USS Winston Churchill (DDG-81) (66 FR 22450) concerning blasting impacts to marine mammals. The data references in the Federal Register data indicates that impacts from explosives can produce lethal and non-lethal injury as well as incidental harassment. The pressure wave from the blast is the most causative factor in injuries because it affects the air cavities in the lungs & intestines. The extent of lethal effects are proportional to the animal's mass, i.e., the smaller the animal, the more lethal the effects; therefore all data is based on the lowest possible affected mammal weight (infant dolphin). Non-lethal injuries include tympanic membrane (TM) rupture; however, given that dolphin & manatee behavior rely heavily on sound, the non-lethal nature of such an injury is questionable in the long-term. For that reason, it is important to use a limit where no non-lethal (TM) damage occurs. Based on the EPA test data, the level of pressure impulse where no lethal and no non-lethal injuries occur is reported to be five (5) psi-msec.

The degradation of the pressure wave

George Young (1991) noted the following limitations of the cube root method:

Doubling the weight of an explosive charge does not double the effects. Phenomena at a distance, such as the direct shock wave, scale according to the cube root of the charge weight. For example, if the peak pressure in the underwater shock wave from a 1-pound explosion is 1000 pounds per square inch at a distance of 15 feet, it is necessary to increase the charge weight to approximately 8 pounds in order to double the peak pressure at the same distance. (The cube root of eight is two.)

Effects on marine life are usually caused by the shock wave. At close-in distances, cube root scaling is generally valid. For example, the range at which lobster have 90 percent survivability is 86 feet from a 100-pound charge and double that range (172 feet) from an 800-pound charge.

As the wave travels through the water, it reflects repeatedly from the surface and seabed and loses energy becoming a relatively weak pressure pulse. At distances of a few miles, it resembles a brief acoustic signal. Therefore, shock wave effects at a distance may not follow simple cube root scaling but may decline at a faster rate. For example, the survival of swim bladder fish does not obey cube root scaling because it depends on the interaction of both the direct and reflected shock waves. In some cases, cube root scaling may be used to provide an upper limit in the absence of data for a specific effect.

More recent studies by Finneran *et. al.* (2000), showing that temporary and permanent auditory threshold shifts in marine mammals were used to evaluate explosion impacts. Due to the fact that marine mammals are highly acoustic, such impacts in behavior should be taken into account when assessing harmful impacts. While many of these impacts are not lethal and this study has shown that the impacts tend not to be cumulative, significant changes in behavior could constitute a “take” under the Marine Mammal Protection Act (MMPA). To address any potential take under the MMPA, the Corps will apply for an incidental harassment authorization from NMFS.

Dual criteria for marine mammal acoustic harassment have also been developed for explosive-generated signals. Noise levels that fall between the 5 psi-msec to a distance where a noise level of 180 dB (3 psi), while outside any physical damage range, can be considered to fall within the incidental harassment zone.

Conservation Measures

It is crucial to balance the demands of the blasting operations with the overall safety of the species. A radius that is excessively large will result in significant delays that prolong the blasting, construction, traffic and overall disturbance to the area. A radius that is too small puts the animals at too great of a risk should one go undetected by the observers and move into the blast area. Because of these factors, the goal is to establish the smallest radius possible without compromising animal safety and provide

adequate observer coverage for whatever radius is agreed upon.

Aerial reconnaissance, where feasible, is critical to support the safety radius selected in addition to boat-based and land support reconnaissance. Additionally, an observer will be placed on the drill barge for the best view of the actual blast zone and to be in direct contact with the blaster in charge.

Prior to implementing a blasting program a Test Blast Program will be completed. The purpose of the Test Blast Program is to demonstrate and/or confirm the following:

- Drill Boat Capabilities and Production Rates
- Ideal Drill Pattern for Typical Boreholes
- Acceptable Rock Breakage for Excavation
- Tolerable Vibration Level Emitted
- Directional Vibration
- Calibration of the Environment

The Test Blast Program begins with a single range of individually delayed holes and progresses up to the maximum production blast intended for use. Each Test Blast is designed to establish limits of vibration and airblast overpressure, with acceptable rock breakage for excavation. The final test event simulates the maximum explosive detonation as to size, overlying water depth, charge configuration, charge separation, initiation methods, and loading conditions anticipated for the typical production blast.

The results of the Test Blast Program will be formatted in a regression analysis with other pertinent information and conclusions reached. This will be the basis for developing a completely engineered procedure for Blasting Plan. During the testing the following data will be used to develop a regression analysis:

- Distance
- Pounds Per Delay
- Peak Particle Velocities (TVL)
- Frequencies (TVL)
- Peak Vector Sum
- Air Blast, Overpressure

Other Rock Removal Options

The Corps investigated methods to remove the rock in the Port of Miami without blasting using a punchbarge. It was determined that the punchbarge, which would work for 12-hour periods, strikes the rock below approximately once every 60-seconds. This constant pounding would serve to disrupt manatee behavior in the area, as well as impact other marine animals in the area. Using the punchbarge will also extend the length of the project temporally, thus increasing any potential impacts to all fish and wildlife resources in the area.

The Corps believes that blasting is actually the least environmentally impactful method for removing the rock in the Port. Each blast will last no longer than 5-seconds in duration, and may even be as short as 2 seconds, occurring no more than three times per day. As stated previously, , the blasts are confined in the rock substrate. Boreholes are drilled into the rock below, the blasting charge is set and then the chain of explosives is detonated. Because the blasts are confined within the rock structure, the distance of the blast effects are reduced as compared to an unconfined blast.

Effects of the Action on Protected Species

Direct Effects

Whales, Sea turtles and Sawfish. Possible direct effects on whales, sea turtles and sawfish include mortality and injury from dredge and blasting operations. Although hopper dredging has negative impacts on sea turtles; clamshell, hydraulic, and cutterhead dredges were determined not to have detrimental direct effects on sea turtles (NMFS, 1997). Since only the latter three types of dredges are likely to be used in the construction of the proposed project, direct impacts on sea turtles from dredging operations are unlikely.

The effects of an underwater explosion on marine mammals, sea turtles fishes are dependent upon many factors, including the size, type, and depth of both the animal and the explosive, the depth of the water column, and the standoff distance from the charge to the animal. Potential impacts can range from brief acoustic effects, tactile perception, and physical discomfort to both nonlethal and lethal injuries. Annoyance of and discomfort to marine mammals and turtles could occur as a result of noninjurious physiological responses to both the acoustic signature and the shock wave from the underwater explosion. Nonlethal injury includes slight injury to internal organs and the auditory system; however, delayed lethality can be a result of complications from individual or cumulative sublethal injuries. Short-term or immediate lethal injury would be a result of massive combined trauma to internal organs as a direct result of proximity to the point of detonation. It is very unlikely that injury would occur from exposure to the chemical by-products released into surface waters (NMFS, 2000b).

Whales – The Corps expects no direct effects (injury or mortality) associated with blasting activities on endangered whales that may be near the project area based on the findings of the NMFS Biological Opinion for the Winston Churchill (NMFS, 2000b).

Sea turtles - There have been studies that demonstrate that sea turtles are killed and injured by underwater explosions (Keevin and Hempen, 1997). Sea turtles with untreated internal injuries would have increased vulnerability to predators and disease. Nervous system damage was cited as a possible impact to sea turtles caused by blasting (U.S. Dept of Navy, 1998). Damage of the nervous system could kill sea turtles through disorientation and subsequent drowning. The Navy's review of previous studies suggested that rigid masses such as bone (or carapace and plastron) could protect tissues beneath them; however, there are no observations available to determine whether the turtle shells would

indeed afford such protection. Studies conducted by Klima *et al.*, (1988) evaluated blasts of only approximately 42 lbs on sea turtles (four ridleys and four loggerheads) placed in surface cages at varying distances from the explosion. Christian and Gaspin's (1974) estimates of safety zones for swimmers found that, beyond a cavitation area, waves reflected off a surface have reduced pressure pulses; therefore, an animal at shallow depths would be exposed to a reduced impulse. This finding, which considered only very small explosive weights, implies that the turtles in the Klima *et al.* (1988) study would be under reduced effects of the shock wave. Despite this possible lowered level of impact, five of eight turtles were rendered unconscious at distances of 229 to 915 m from the detonation site. Unconscious sea turtles that are not detected, removed and rehabilitated likely have low survival rates. Such results would not have resulted given blast operations confined within rock substrates rather than unconfined blasts. The proposed action will use confined blasts, which will significantly reduce the area around the discharge where injury or death may occur.

Sawfishes - Review of ichthyological information and test blast data indicate that fishes with swim bladders are more susceptible to damage from blasts, and some less-tolerant individuals may be killed within 140' of a confined blast (USACE, 2000a). Sawfishes, as chondrichthyans, have no air bladders, and, therefore, they would be more tolerant of blast overpressures closer to the discharge, possibly even within 70' of a blast.

Johnson's Seagrass - Johnson's seagrass (*H. johnsonii*) beds will not be directly or indirectly affected by project actions, as no population has been observed in the action area or the vicinity of the action area. Although *H. johnsonii* has been reported to occur in north Biscayne Bay, no *H. johnsonii* was encountered within the study area (DC&A 2001, Appendix E). Further, past field surveys conducted by resource agency personnel and for other studies of the Port have failed to identify *H. johnsonii* within the study area (Craig Grossenbacher, DERM, 2002, personal communication). Portions of the action area where deepening will occur (federally authorized channels) are excluded from designated critical habitat, and therefore impacts to critical habitat will not occur. However, where widening will occur in the Biscayne Bay (Fisherman's Channel and Fisher Island Turning Basin), substrates that fall within critical habitats will be removed. It should be noted though, that these substrates are not amenable to colonization by Johnson's seagrass because they are currently occupied by beds of other species of seagrass; a "colonizing" species such as Johnson's seagrass would not be able to establish a population due to interspecific competition (see discussion of the natural history of the species above). Therefore, the proposed project is not likely to adversely modify designated critical habitat of Johnson's seagrass.

Mitigative Measures - Due to conservation safeguards (see "Conservation Measures" below) that will be implemented for the proposed project, no direct impacts on whales, sea turtles or sawfish are anticipated. To avoid or minimize any possibility of direct impacts, blasting is not anticipated to occur offshore where mature females may be migrating to nesting areas in the county. Risk to sawfish will be miniscule as there are no historic or recent records of the species in the project area.

Indirect effects

The regulations for interservice consultation found at 50 CFR 402 define indirect effects as “are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur”.

Whales - The Corps believes that whales that may be near the project area may be harassed acoustically as a result of the blast detonations. This harassment is expected to be in the form of a temporary threshold shift (TTS), which is a change in the threshold of hearing which could temporarily affect an animal’s ability to hear calls, echolocation, and other ambient sounds.

Sea Turtles

Disorientation due to lighting - One possible element of the action that may indirectly affect sea turtles is the presence of light and/or noise from construction/dredging vessels anchored offshore. These factors may interrupt the movement of adult, nesting, female turtles swimming toward or away from nesting beaches, and may cause disorientation of hatchlings following emergence. However, since the port is an active facility, offshore lighting is not an unusual feature of the area, and should not appreciably change the ambient conditions of nesting areas in the vicinity of the action. In addition, all construction/dredging vessels are required to adhere to best management practices, such as preventing lights from exposure to shore through use of shields, as required by NMFS in its 1997 Biological Opinion (NMFS, 1997) and adopted by the Corps in its standard specifications for working in areas where sea turtles may be present. Therefore, no adverse indirect impacts due to dredging operations are anticipated for the proposed action.

Acoustical Harassment - The Corps believes that turtles that may be near the project area may be harassed acoustically as a result of the blast detonations. The harassment is expected to be in the form of a TTS.

Habitat Modification - Both seagrass habitats and reefs provide resources utilized by sea turtles. Approximately 1/4-acre of seagrasses will be removed during construction, and six acres of seagrass beds may experience declined productivity and/or senescence over the next several years. In addition, approximately 3.3 acres of non-previously-dredged reef/hardground habitat will be impacted. Nevertheless, detrimental indirect impacts on sea turtle populations are not anticipated. (In fact, fish and invertebrates killed or injured by blasting may provide a short-term enhancement of foraging opportunities for sea turtles.) Because of the abundance of both seagrass beds and reefs in the vicinity of the action area, and because the project entails the creation of approximately ten acres of substrates suitable for recruitment at a nearby mitigation site and over six acres of artificial reef habitat, the Corps does not anticipate that the proposed project will have any indirect effects on sea turtles in the vicinity of the action area. In addition, because no critical habitats for sea turtles are found within the action area, no indirect impacts to the species will be incurred due to modification of critical habitat.

Smalltooth Sawfish

Although seagrass and other softbottom habitats will be removed, the Corps does not anticipate that the proposed project will have any indirect effects on smalltooth sawfish in the vicinity of the action area. These habitats may be utilized by the species. However, as noted above, loss of seagrass habitats is relatively small with respect to nearby resources, and will be compensated through mitigative measures.

Nearshore softbottom areas are also plentiful in and near the action area, and impacts to them would not limit resource use by sawfish, especially since population density of individuals in the area is extremely low, if not nil. In addition, because no critical habitats for sawfish have been determined, indirect impacts to the species through loss of critical habitat cannot be considered.

Interrelated and Interdependent Effects

The regulations for interservice consultation found at 50 CFR 402 define interrelated actions as “those that are part of a larger action and depend on the larger action for their justification” and interdependent actions as “those that have no independent utility apart from the action under consideration.”

The Corps does not believe that there are any interrelated actions for this proposed project; however, the recommended plan for the Port of Miami contains widening components and deepening components. As a result of the widening and deepening components of the project, larger container and cruise vessels will call at the Port of Miami. As a result of both the widening and the deepening components of the project, more tonnage will be carried per vessel call, so the total number of vessel calls may be reduced (Dawedit 2002. pers comm.). This will be an indirect benefit to the whales, sea turtles and sawfish since there will be fewer ships in the area to potentially affect them. Additionally, the wider channel will provide sea turtles and sawfish more room to maneuver around incoming and outgoing vessels throughout the action area.

Cumulative Effects

The regulations for interservice consultation found at 50 CFR 402 define cumulative effects as “those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consideration.” The Corps is not aware of any future state or private activities, not involving Federal activities that are reasonably certain to occur within the action area.

Take Analysis

Due to the restrictions and special conditions placed in our construction specifications the Corps does not anticipate any injurious or lethal take of endangered whales, endangered/threatened sea turtles, or proposed endangered smalltooth sawfish. The Corps does expect take through harassment in the form of TTS for sea turtles and endangered whales that may be near the action area. The Corps does not anticipate any take of Johnson’s seagrass, since the species has not been reported in the project area.

Determination

The Corps has determined that the proposed expansion and deepening of Miami Harbor is likely to affect, but not likely to adversely affect listed species within the action area. The Corps believes that the

restrictions placed on the blasting previously discussed in this assessment will diminish/eliminate the effect of the project on protected species within the action area.

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